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TABLE OF CONTENTS.

ENGINEERING NEWS OF THE WEEK..... 401
A Water Power Pumping Plant for Irrigation (illustrated) 402
Railway Economics..... 402
A New Rod for Level and Studio Work (illustrated) 403
Steel Garbage-Collecting Wagon (illustrated)..... 404
The Use of Water-Tube Boilers in the Navy..... 404
The Welsbach Incandescent Gas Burner..... 407
Building Stone Roads in Country Towns..... 407
The Appointment of Civil Engineers in Kentucky 407
Failure of a Masonry and a Rock Foundation.. 407
The Metropolitan Sewerage Systems of Massachusetts (illustrated)..... 412
The New Steamer "Priscilla"; Fall River Line (illustrated)..... 413
A New System of Connecting Engines and Dynamos (illustrated)..... 414
Adjustable Traveler for Erecting the Winona Bridge (illustrated)..... 415
Reconstruction of a Portion of the Substructure of the Johnsonville Bridge..... 415
Roadbed Cross-Sections; C., C., C. & St. L. Ry. (illustrated) 416
Razing a Chimney with Dynamite (illustrated).. 416
PERSONALS, NEW PUBLICATIONS, SOCIETY PROCEEDINGS..... 408
EDITORIAL NOTES..... 410
Railway Economics—Chief Engineer Isherwood on Internally-Fired Boilers—Comparative Cost of Wooden and Fireproof Construction for Dwellings—The Danger of Inflammable Interior Finish in Buildings.
EDITORIAL:
The Rise of the Railroad Club..... 410
LETTERS TO THE EDITOR..... 411
How Not to Make Concrete for Brick Paving Foundations—Proposed State Water Supplies in New Jersey—Sandberg's Sections for 100-lb. Rails.
CONSTRUCTION NEWS..... 416
Railways, Street and Electric Railways, Elevated Railways, Highways, Bridges and Tunnels, Water-Works, Artesian Wells, Irrigation, Sewers, Streets, Electric Light and Power, Miscellaneous Contracts and Supplies, Bids Asked, Contract Prices, Metal Market Prices.
INDUSTRIAL NOTES..... 420

The Lewis system of electric lighting has been tried on one of the cars of the Brooklyn Bridge with satisfactory results, but the cost of equipment and operation has not yet been determined.

A dam for water storage on the Genesee River is desired by the city of Rochester, N. Y., to secure a sufficient supply for manufacturing purposes, as the state uses a large quantity of the water for feeding the Erie canal in the dry season.

The new passenger steamer "Northwest," for lake service between Buffalo and Duluth, made a run of 19 miles in 51 minutes on a recent trial trip.

The eight-wheel engine, No. 655, of the Lehigh Valley R. R., made a fast run May 7, with one car, attaining a speed equivalent to 82½ miles per hour. The leading dimensions are as follows:

Driving wheels, diam.	5 ft. 9 ins.
Weight on driving wheels	82,208 lbs.
" of engine	115,808 "
" of engine and tender	190,400 "
Cylinders	20 × 25 ins.
Boiler, diameter	5 ft. 1 in.
Firebox, Wootten	10 ft. × 7 ft.
Tubes, 271; diam. out., 2 ins.; length	13 ft. 7½ ins.
Capacity of tank	4,000 gallons

A bill providing for the abandonment by the state of the Hocking Canal between Carroll and Nelsonville and its lease to the Columbus, Hocking & Athens R. R. for 99 years at $6,000 per year is before the Ohio legislature. The canal cost about $400,000, and the section from Nelsonville to Athens, 15 miles, was abandoned and given to the Columbus, Hocking Valley & Toledo R. R. Co. at the time that road was built. The state did not receive a dollar for that property. The remaining part of the canal, 41 miles long, is practically valueless to the state so far as revenue is concerned, as in the last ten years it has cost the state over $79,000 more than has been received from it. Mr. E. M. Poston, of Nelsonville, O., is interested in the new railway.

The King electric railway system, with underground conduit, is being tried on the Tenleytown railway at Washington, D. C. Two "plows" on the car force back the flexible cover of the slot, which consists of hinged iron plates with a continuous strip of waterproof rubber belting underneath. The cost is estimated at $10,000 to $12,000 per mile.

The system of railway accounting devised and perfected by Mr. M. M. Kirkman, Vice President of the Chicago & Northwestern Ry., is being introduced by Stromberg, Allen & Co., of Chicago. The importance of systematic accounting in railway service is very great, as upon it depends the ability or inability to determine in what departments economy or wastefulness is practiced, and the practical value of Mr. Kirkman's system has been demonstrated in service on the Chicago & Northwestern Ry.

The most serious railway accident of the week was the derailment of a passenger train on the Auburn Division of the Lehigh Valley R. R., about 2½ miles from Owego, N. Y., May 14, in which one person was killed and 14 were injured, some seriously. New rails were being laid and it is reported that the section men had insufficiently spiked the last rail laid before they quit work for dinner. A correspondent writes as follows: "New rails were being laid, and the workmen were at dinner close by, but the track was supposed to be in safe condition. The train consisted of one combination and one day coach. As near as we can judge, one of the trucks of the coach first left the track on east side, or outside of curve, and to all appearances the outside wheels were carried on the extra rails which laid along the track for a distance of 50 ft., the inside running on the ties, then mounted the rails to the west side and ran about 400 ft., when the car tipped over and came to a stop at the end of the cut, with the bottom toward the track. The combination car continued about 200 ft., when it rolled over, stopping with the top of car toward the track. The locomotive continued 200 ft. further, when it stopped, with tender and driving wheels off the track on the west side, but truck wheels still on the track. The train was making about 50 miles per hour on a 40-ft. down grade. Those in the coach were the most injured, one person being killed. Some of the railway officials think the first marks were not made by the truck wheels, but by brakeshoe or something of that kind, and that the car did not leave the track until it left on the west side." Another serious accident was a head collision on the Chicago & Northwestern Ry., near Menominee Junction, Minn., May 10, between a passenger and freight train, in which two persons were killed and three injured.

The Pickering bridge, on the Frazer branch of the Pennsylvania R. R., near Phoenixville, Pa., was burned May 8. It was a wooden bridge 200 ft. long and 70 ft. high. The fire was caused by sparks from a locomotive.——A passenger train on the Hannibal & St. Louis Ry. went down with a bridge at Peno Creek, near Bowling Green, Mo., May 10. Three men were injured. The abutments were supposed to have been undermined by heavy rains.——Four bridges near Toms River, N. J., have been destroyed by forest fires, and several road bridges over the Patapsco River, in Maryland, have been carried away by floods.——The Washington St. bridge at Tiffin, O., gave way under the city's steam roller on May 1.——One pier and one span of the new railway bridge across the Menominee River at Menominee, Mich., were washed away April 24.——A road bridge over Johnson Creek at Ave Gres, Mich., gave way under a team, April 23.——The 50-ft. south span of the bridge at Buctouche, N. B., was carried away by the ice on May 7.

A train was derailed in San Salvador, Central America, May 15, and 100 persons are reported killed or injured. It was apparently a troop train.

The Westinghouse Electric & Mfg. Co.'s annual report shows that the company's net profit for the fiscal year foots up $640,809. This is after charging to operating expenses large sums for alterations and additions to plant, and interest and discount. The company received on its World's Fair lighting contract $309,000 and $88,704 for extras. Much is expected from its long distance power transmission business when the three 5,000-HP. generators are in operation at Niagara Falls.

Tracklaying at the rapid rate of 10,000 ft. in ten hours was done on the Southern Pacific Co.'s line to San Luis Obispo, Cal., on May 3 in order to keep its agreement to have trains running by May 5.

Oil fuel for locomotives is being tried by the Chicago, Burlington & Quincy Ry. A switch engine has been fitted supplied with the attachment for burning oil used on the Pennsylvania R. R. two years ago, which proved successful, although not so cheap as coal. A passenger engine has also been fitted with the Holden apparatus, used successfully on the Great Eastern Ry. in England. The changes required in the engines are not extensive or costly. An oil tank containing 200 gallons of oil is placed in the tender, with two pipes and two burners extending into the firebox, with steam injectors attached, which spray the oil into every part of the firebox over a bed of incandescent coal.

Awards to the amount of $202,850 have been made by commissioners appointed to appraise damages in connection with the new water supply of Syracuse, N. Y., caused to owners of water rights on Skaneateles Creek by the diversion of 15,000,000 gallons of water per day from Lake Skaneateles. In 1889 Mr. J. J. R. Croes, M. Am. Soc. C. E., estimated the value of 41 mill rights along this stream at $742,000, an average of $11,500 each. The award just noted was for 18 rights, and averages $11,266 each. For the 18 rights in question the owners demanded a total of $1,397,000, the water commissioners in their original application for appraisal valued the same rights at $215,000 and the appraisers awarded $202,850, as already stated. The various demands ranged from about 6 to 30 times the awards.

The engineering laboratory at Purdue University, which, as our readers will remember, was destroyed by fire on the night of Jan. 23 last, only four days after its completion and dedication, has been already largely replaced, and the work is expected to be completed so that every machine, tool and piece of apparatus formerly in the laboratories will be in place and ready for use by the opening of the fall term, Sept. 14 next. Besides this, the trustees have arranged for improvements to the laboratories which will make them in some respects more complete than any other in the country for railway testing work. The new locomotive testing plant has been carefully revised in reconstructing it. Its parts will be made adjustable and will be connected by a track with the Lake Erie & Western R. R., so that any locomotive from any part of the country may be tested. A new traction dynamometer made up of the weighing levers of an Emery testing machine of 30,000-lbs. capacity has been specially designed and is now in process of construction by Wm. Sellers & Co. The "Schenectady" locomotive, which passed through the fire, is being repaired at the Pennsylvania R. R. shops at Indianapolis. In the steam engineering laboratory the two engines of a Vauclain compound locomotive are to be mounted as stationary engines with the exhaust piped to a surface condenser to give an accurate measurement of the steam consumption. The steam engineering laboratory will also contain a Straight Line engine, a Buckeye engine, a De Laval steam turbine, and a Kimble combined engine and boiler. For testing materials the university has purchased the 300,000-lb. upright Riehle testing machine exhibited at the Columbian Exposition, which will take specimens up to 10 ft. in length for either tension or compression. Another notable feature of the laboratory will be a gas room, which will contain among other apparatus two experimental gas engines and two railway car lighting equipments, one of the Frost Dry Carbureter system and one of the Pintsch compressed gas system. The success which has been attained in the reconstruction and equipment of the laboratories is due to the untiring industry of those in charge, including especially Prof. W. F. M. Goss, M. Am. Soc. M. E., Professor of Experimental Engineering. Manufacturers of apparatus and machinery have extended liberal terms to the university, and many have made repairs or have exchanged old machines for new without charge.

The National School of Electricity has been incorporated in Illinois. Its object is the establishment of a popular school of electrical science in nearly every city. It originated from the electrical congress at Chicago last summer. The officers of the corporation are: President, J. P. Barrett; Vice-President, J. L. Little; Treasurer, E. L. Powers; Secretary, J. Allan Hornsby. The office is in the Monadnock Block, Chicago. It is the intention to organize a class in electricity in every city and town the population of which is large enough to justify it. The class will meet once a week for 40 weeks, and will be provided with a study leaf, which will take the place of text-books. The lessons will be short and taught in language that people with limited education can readily comprehend. After covering the first principles the lessons will proceed along practical lines to the subject of the construction and operation of the various classes of apparatus. The tuition fee, which is $12.50, is placed at a figure supposed to be in the reach of every student. It is intended to merely cover the actual running expenses of the school, the preparation of the course of instruction, and its presentation in an effective manner before the class, and to leave a small margin for the foundation of a fund devoted to the complete scientific education of a small percentage of the students on the principle of scholarships.

Mr. Chas. T. Porter, M. Am. Soc. M. E., the veteran steam engineer, has been at work for a considerable time on a new form of steam engine, and patents No. 517,982 and 517,983 have just been issued upon the invention. Mr. Porter imitates Willans, the famous English inventor, by adopting a fixed point of cut-off and regulating the speed by throttling; but he operates the valve by a cam and claims great superiority for the valve motion.

A WATER-POWER PUMPING PLANT FOR IRRIGATION.

By Frank Bartlett, Chief Engineer Prosser Falls Irrigation Co.

A pumping plant has been lately put in at Prosser Falls, Wash., to irrigate 4,000 acres, and arrangements have been made to furnish water power to the different factories soon to be erected. North of Prosser Falls, across the river, lie 65,000 acres covered by the Sunnyside Canal; and above the Sunnyside Canal are 100,000 acres which will be watered by the high line of the same canal. The larger part of this land will be tributary to Prosser. South of Prosser lies the great "Horse Heaven" wheat and cattle country. Prosser is the nearest railroad station and is the natural outfitting point for this country. On the north side

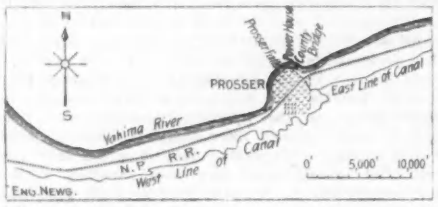


Fig. 1. Map Showing Location of Prosser Falls Irrigation Co.'s Power Plant and Canals.

of the Fall, water is taken out for the Leadbetter Canal to irrigate land on the lower Yakima and Columbia rivers.

The Prosser Falls Irrigation Co. controls the south side of the river. The land on this side of the river is too high to be covered by a gravity system and though it is as productive as any in the state it would be worthless without water. The power of the falls is utilized to raise water 100 ft. high to cover this land. The water power here is the best on the Yakima River. The fall is 20 ft. in a half mile, and during the dry season in October, 1893, the river had a flow of 2,662 sec.-ft., equivalent to 6,050 HP.

The location of the company's power plant and canals is shown by the accompanying map, Fig. 1. The headgates are placed in the rock on the south side of the river. The headgate frame is made of 16×16-in. timber, is 22 ft. high and 36 ft. wide, and has six openings for gates, each 4 ft. wide in the clear. In front of the headgate frame is a rack frame made of 12×12-in. timber, on which rest the racks, which will keep floating timber and ice out of the wheels. These racks consist of flat iron bars 14 ft. long, which are placed 1 in. apart in the clear. A wing dam has been built from the headgates out into the river to direct the current toward the flumes.

The headgates supply two flumes, each 10 ft. deep and 12 ft. wide in the clear, and the water will be 6 ft. deep in the flumes when the river is the lowest. One of these flumes will supply water to the factories. The other furnishes water for the irrigation canal and the power to raise that water 100 ft.; also water to supply the town. From the headgates to the power house is 650 ft. Part of the fall is lost during high water and the machinery has been designed for a 12-ft. fall. The flume connecting the headgates and power house is made of 2-in. tongue-and-groove plank with bents every 2 ft., made of 6×10-in. timber. The water from the flume enters a fore-bay 10 ft. wide, 17 ft. deep and 68 ft. long and from the fore-bay enters three penstocks, from which it is discharged through the turbines.

The turbines are 48-in. special Victor turbines and develop 135 HP. each under 12 ft. head. Each turbine drives a duplex power pump, 25-in. cylinder, 24-in. stroke, each pump having a capacity of 4,000 gallons per minute. This is the discharge at an 80 ft. per minute piston speed and the pumps can, when necessary, be run at 100-ft. piston speed. Two pumps and two turbines are now in successful operation and when the third pump is in the plant will have a daily capacity of 17,280,000 gallons. The turbines and pumps were furnished by the Stilwell-Bierce & Smith-Vaile Co., Dayton, O. A view of the two pumps, taken before the erection of the power house, and of the flume leading to the turbines, is shown by Fig. 2.

From the pumps this water passes through 2,800 ft. of 28-in. steel pipe and is discharged at the head of the company's canal. After the first 700 ft. the canal divides into two branches. The west is nine miles long and the east is now three miles long and it is expected to continue it down the river to cover a fine piece of land several miles beyond. The water supplied to the canal is 27 sec.-ft., which at a duty of 150 acres to the second-foot will irrigate 4,000 acres. Mr. J. G. Van Marter, Jr., is president and Mr. Fred. R. Reed is general manager of the company.

RAILWAY ECONOMICS.*

The inventions and improvements in colliery tramways which made railways available for public use originated with practical mechanics, and gave such prominence to the profession of engineering that in those early days engineers alone were selected as railway managers. The general acceptance of railways as common carriers led to such a recognition of the importance of the art of transportation by rail that men who evinced an aptitude for handling trains successfully then became in demand as managers. With the increase in the number of railways the competitive traffic virtually overshadowed the difficult problems in construction and transportation which had given value to the successful engineer and transportation official, and as the traffic manager got nearer to those who controlled competitive shipments, his importance increased with the board of directors.

In the desire to augment the published gross earnings by a larger volume of business, the experience and the information pertaining to the science of engineering and to the art of transportation have been somewhat disregarded. It has been assumed that so long as the gross earnings are maintained or increased, the standard pro rata of expenses to earnings should not only be maintained, but even diminished, and that the cost of the service should be reduced with the reduction in the rate charged for it. The efforts to take away each other's business have been pursued with such zeal and ingenuity that the surplus revenue can no longer furnish the means for improvement, nor for liberal operation, except by a reduction of the dividend fund. The matter of pressing moment is to eke out

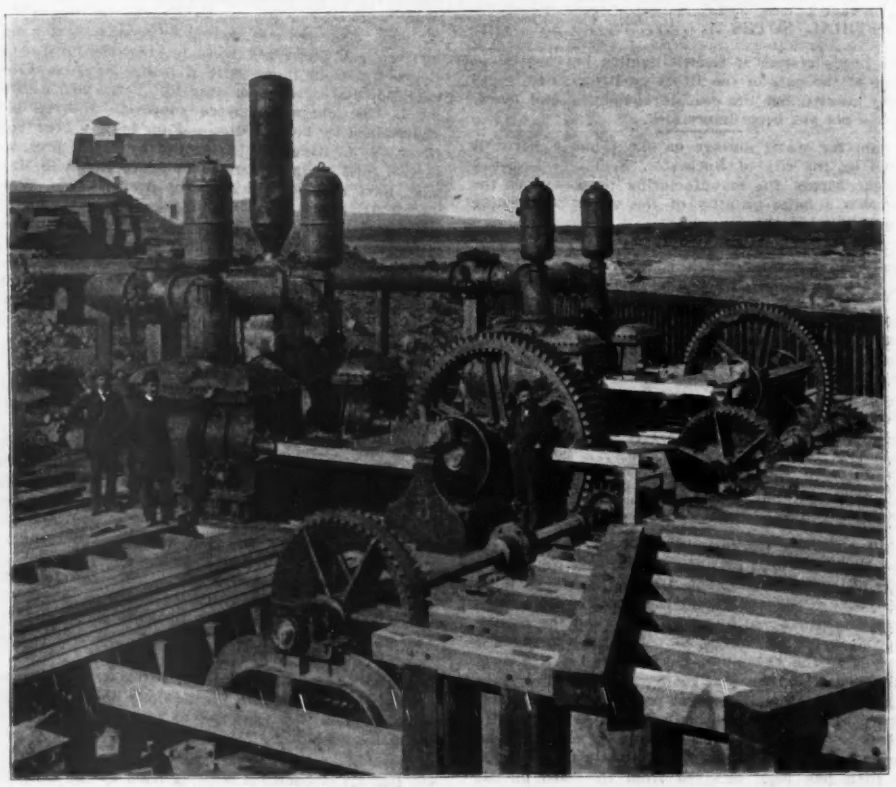


FIG. 2. VIEW OF POWER PUMPS OF PROSSER FALLS IRRIGATION COMPANY.

the dividend from the fund set apart for operating expenses, and it has therefore seemed to me that a timely topic for my address would be the reduction of expenses in railway operation.

In discussing the reduction of expenses we must keep in view the distinction between the expenditures made for performing the service of transportation and for maintaining the property in present condition, that is the ordinary expense account, and those made for the purpose of improving the condition of the property, or for increasing its capacity to perform the service of transportation, that is the extraordinary expense or improvement account. The responsibility of the railway manager is different with respect to these two classes of expense. He is not bound to give the public improved service at the expense of his stockholders, though it is plainly his duty to give safe service. He must not seek economy at the expense of safety. To a certain extent he can economize with a decrease in traffic by a diminution in the number of trains, and the expenditure for freight handling may be somewhat reduced with decreased tonnage, though the expenses which fluctuate with train mileage and with tonnage constitute a relatively small portion of the total operating expenses, and outside of train service and freight handling, the general service can be but little diminished with the diminution of traffic in a period of temporary depression. But when the same tonnage is handled at reduced rates, the same work must be done, that is, if the road is ordinarily operated with due regard for economy, but less money must be paid for doing it. When it comes to doing the same work for less money, the reduction must be made by paying less for men or materials, or for both. This reduction will at first be made in quantity, as far as that is practicable. You will reduce your force and your stock of supplies. But when the minimum has been reached, below which the standard of efficiency would be impaired, then any further reductions must affect the pay of the men and the prices of the supplies. Naturally, we leave the wages until the last, and seek to bear down the cost of the supplies. This cannot be carried very far without affecting their quality, and it is a matter which comes of long experience and of intimate acquaintance with their manufacture to be able to determine whether the reduction in prices has not been attained by such a reduction in quality as substantially to make the lower priced article dearer than that for which a higher price is asked.

But when you have reached your limit in reducing your force, and in cheapening your supplies, you have but one other direction in which to seek still further economy, and that is in a reduction of wages. Will you insist upon a horizontal reduction of so much per cent., or will you make the percentage of reduction decrease with the rate of pay? Every step that you take will meet with opposition from those that are to be hurt by it, and where such opposition can be strongly organized you will be tempted to ease up in that direction, and to lay a heavier load on those who cannot offer so much resistance. The principal considerations then in an enforced reduction of expenses are to de-

* Abstract of the address by Col. H. S. Haines, President of the American Railway Association, at the meeting in New York, April 11.

termine the extent to which such a reduction can be applied, as between men and materials, and the fairest way of applying a reduction to men's wages.

About two-thirds of the ordinary operating expense account go to salaries and wages, the remaining third is applied to supplies, implements and all other items which may be briefly termed materials. I will endeavor to illustrate by an example the effect of such a reduction on a road 500 miles long, with gross earnings of $6,000 per mile, which is, perhaps, an average example of the length and earnings of a railway in this country, and will assume that such a road would ordinarily be operated with economy at 66% of the gross earnings.

Gross earnings, say of....	$3,000,000	$2,700,000
Operating expenses.....	2,000,000	1,800,000
Surplus	$1,000,000	$900,000

Now with gross earnings reduced 10%, or $300,000, the manager would be expected still to operate it for 66%, which would be as shown in the second column.

This would be a uniform decrease of 10% in gross earnings in the fund for operations, and in that fund also from which fixed charges and dividends are to be paid. The manager would then have to decide how to reduce his expense account from $2,000,000 to $1,800,000. As wages constitute about two-thirds of the total cost of operation, two-thirds of the reduction should be made from wages, and the other third from what I have termed materials. The division of this 10% reduction would then be as follows:

Wages reduced from.....	$1,334,000	to $1,200,000
Materials, etc., from.....	666,000	to 600,000
Total, from.....	$2,000,000	to $1,800,000

But if you will classify the items which are not wages, you will find that some of them you cannot reduce, because they are not under your control. For example, there are legal expenses, insurance, injury to persons and property, bridge material, cross-ties, rails, frogs and switches, fuel, car mileage balances, loss and damage to freight, and other items which will also occur to you. But considering only those which I have enumerated, one-fourth of the total cost of operations is for items that you cannot touch, and the reduction of 10% in the total cost of operations must fall upon 75% of that total, which means a reduction of over 13% in wages and in other items, the cost of which can be controlled by the management. The total reduction in each department will vary with the varying percentage of uncontrollable items that are charged to that department. In referring to these departments I classify them as follows:

Administrative department, including so-called general expenses and expenses of purchasing agencies.

Roadway department, including all expenses pertaining to maintenance of way and structures.

Machinery department, including maintenance of motive power and rolling stock, also fuel and wages of locomotive crews.

Transportation department, including wages of train men.

Freight and passenger department, including all station agents, clerks and laborers employed in billing and handling freight and passengers.

The total expense account of $2,000,000 would be divided among these several departments about as shown in the first column of the table, while the percentage of total expenses in each department which goes for wages varies materially, but is about as given in the second column:

			Reduction. In wages.	Reduction. In other items.	Reduction. Total.
Administrative dept..	9%	28%	$5,000	$5,000	$10,000
Roadway dept.....	20 "	55 "	30,000	3,000	33,000
Machinery dept.....	37 "	59 "	60,000	15,000	75,000
Transport. dept.....	15 "	75 "	30,000	3,000	33,000
Frght. and pass. dept.	19 "	89 "	45,000	4,000	49,000
Total			$170,000	$30,000	$200,000

Any uniform reduction in pay will therefore affect each department very differently. For instance, 89% of the total cost of operating the freight and passenger department would be affected, while in the administrative department only 28% would be affected. On this basis the total reduction of $2,000,000 would be borne in each department as shown in the three last columns.

On such a road as I have used for an illustration, out of a total expense account of $2,000,000, about $1,270,000 would go for salaries and wages, and of this amount about $410,000 would be paid to enginemen, firemen, trainmen, switchmen and telegraph operators. Where these classes of employees are protected against reduction of wages by contract, the total reduction must fall upon those classes which are not so organized, and whose wages would amount in all to about two-thirds of the pay roll account. Under such conditions the result of an apparent reduction of 10% in total expenses would be to reduce by 20% the salaries and wages of all officials and employees whose pay was not fixed by contract.

It is a matter for traffic officials to ponder upon, when they are cutting rates to take away each other's business, that the reduction in gross earnings thereby occasioned must be made good from operating expense account. In the case which I have worked out as an illustration, if a reduction of 30 cts. per ton had been made on a considerable volume of traffic, coal, for instance, 10 cts. would have come out of the fund available for fixed charges and dividends, 3 cts. out of the vouchers paid supply men, etc., and 17 cts. out of salaries and wages, that is, if the reduction was uniformly distributed.

Is there no way to stop this continuous shrinkage of rates on competitive traffic? It is the most serious problem which confronts the railway managements of this country at the present time. The total volume of this business is not increased by such reductions, though the total revenue derived from it is proportionately diminished; however, the total loss may be distributed among the competitors. It is not possible, from available statistics, to separate the tonnage and revenue of competitive and local traffic. The totals are given in the Interstate Commerce Commission report for 1892 as, in round numbers, 88,000 million ton-miles and 730 million dollars. The total common stock is given at 3,978 million dollars, and the total dividends on common stock at 79 million dollars, an average dividend of 2%. Over 70% of the total common stock received no dividend whatever. An increase of one mill per ton-mile on the total tonnage in 1892 would have resulted in increased net earnings of 88 million dollars which, if added to the total amount paid in dividends on common stock, would have raised the average dividend from 2 to 4%. What possibilities there would be in such improved earnings for better service, for greater facilities, for higher wages, for increased sale of supplies, for a general advance in the value of railway securities, and, indeed, for brighter prospects in every field of industry in this country of ours, where the railway is so important a factor.

But why present such a picture to the railway manager, whose daily task is to make yet another turn of the screw on operating expenses; a vision of that which is as impossible as it is attractive. And why is it impossible? Why is it that authority should be given to traffic officials arbitrarily to reduce rates regardless of the cost of performing the service? Because the men who are responsible for gross earnings are responsible for nothing else. They have gone on from year to year, each striving to snatch as much as he could from the common reservoir of traffic, and the swelling tide of the nation's prosperity kept the bowl ever full and overflowing. The contest in which each sought to get the largest share became so exciting that all other considerations were set aside, not only considerations of cost and value of service performed, but even of good faith, and I may say of common honesty. In what an off-hand manner 5 cts. would be taken off a rate of 25 cts. per 100 lbs. for 1,000 miles haul. Yet the rate was only ½ ct. per ton-mile, and the cut of 5 cts. was a reduction of 20% in the total rate. And I have known such sweeping reductions to be made in a vaunting way, on the spur of the moment and in a spirit of resentment because of some offensive action by a competitor.

The time has arrived in the development of this country's resources and of its railway system when such a policy in the management of competitive traffic cannot be persisted in without disastrous consequences. The increase in the volume of such traffic is proportionately less year by year; the bowl is no longer overflowing. But the competitors are increasing; year by year others are tapping the reservoir. Either the volume of tonnage must increase more rapidly than the rate diminishes, or the total revenue from competitive traffic must decrease. That is just what is taking place, and the shortage must be made good by reduction in operating expenses.

As I have just asked, Is there to be no end to this shrinkage of rates? Will it avail anything with our traffic officials to impress upon them the fact that the point has been reached at which each further step in economy means another step in the reduction of wages? I believe that it will; that the men who display so much intelligence in outwitting each other to get business are competent to recognize that there is a point below which the rate is less than the cost of the service, and that when that point is reached they can in no way more successfully get the best of a competitor than by forcing him to take the business.

But how can that point be ascertained? Not by figuring out the average rate per ton-mile. The statistician who devised that standard of performance is responsible for most of the ills which railway properties have suffered. It is so easy to make the calculation, once the total ton mileage and the total revenue are known, that it has been made the basis of comparison by Wall St. brokers, grangers, demagogues, legislators, all who had a moral to enforce, or a tale to tell at the expense of some unfortunate railroad management or corporation. It serves no practical purpose. It has no actual existence. It is a mere figment of the brain. Yet it is the father and the mother of the long-and-short-haul idea; it is the standard for operating expenses, and it is the only yardstick that is put in the hands of the traffic official, when he is measuring off competitive traffic. No better service could be done for our railroads than to demonstrate its insufficiency, its utter nothingness; to dissolve the phantom into the thin air whence it came. We move freight by car loads, not by tons, and it is by car-miles and not by ton-miles that the cost of the service should be reckoned. Add to this standard the cost of terminal service, and you will give the traffic official the means for ascertaining the dividing line between profit and loss in making rates on competitive traffic. And you will have a standard by which the work of the operating official can be fairly measured, also one which may be used to demonstrate to the local shipper that he is not the patient ass which is carrying the long haul shipper on his back. I feel sure that the more you think of it—you on whom falls the duty of reducing expenses as the rates are reduced, you will see how important it is that the cost and value of the service that you are responsible for should be measured by this rational standard, rather than by one which helps no one and proves nothing—a standard which, if intelligently used by the traffic official, will deter him from reducing rates at the expense of wages, and will assure a profitable revenue from the entire volume of competitive traffic; a standard which will account for the aid rendered by heavier locomotives, lighter grades and curves, and every other improvement which cheapens the service and makes up the sum of possible economies in railroad operation.

To the traffic officials the stockholders must now look for relief. The prosperity of their property is no longer in the hands of the operating officials. Human ingenuity seems to have about done its utmost to give cheap transportation by rail. Every available invention has been adapted to that purpose, and if the limit of economic results has not yet been attained, it has been so nearly reached that the small percentage yet to be saved can only be gained by painful methods more characteristic of a country and of an industry tending to decay than of a great people full of energy and resource, and of the greatest factor in modern civilization.

A NEW ROD FOR LEVEL AND STADIA WORK.

We show herewith a recent design for a rod for work with level or stadia made by Mr. C. K. Allen, a student in the Missouri School of Mines, at Rolla, Mo. We are indebted to him for a drawing of the rod from which our illustration is prepared.

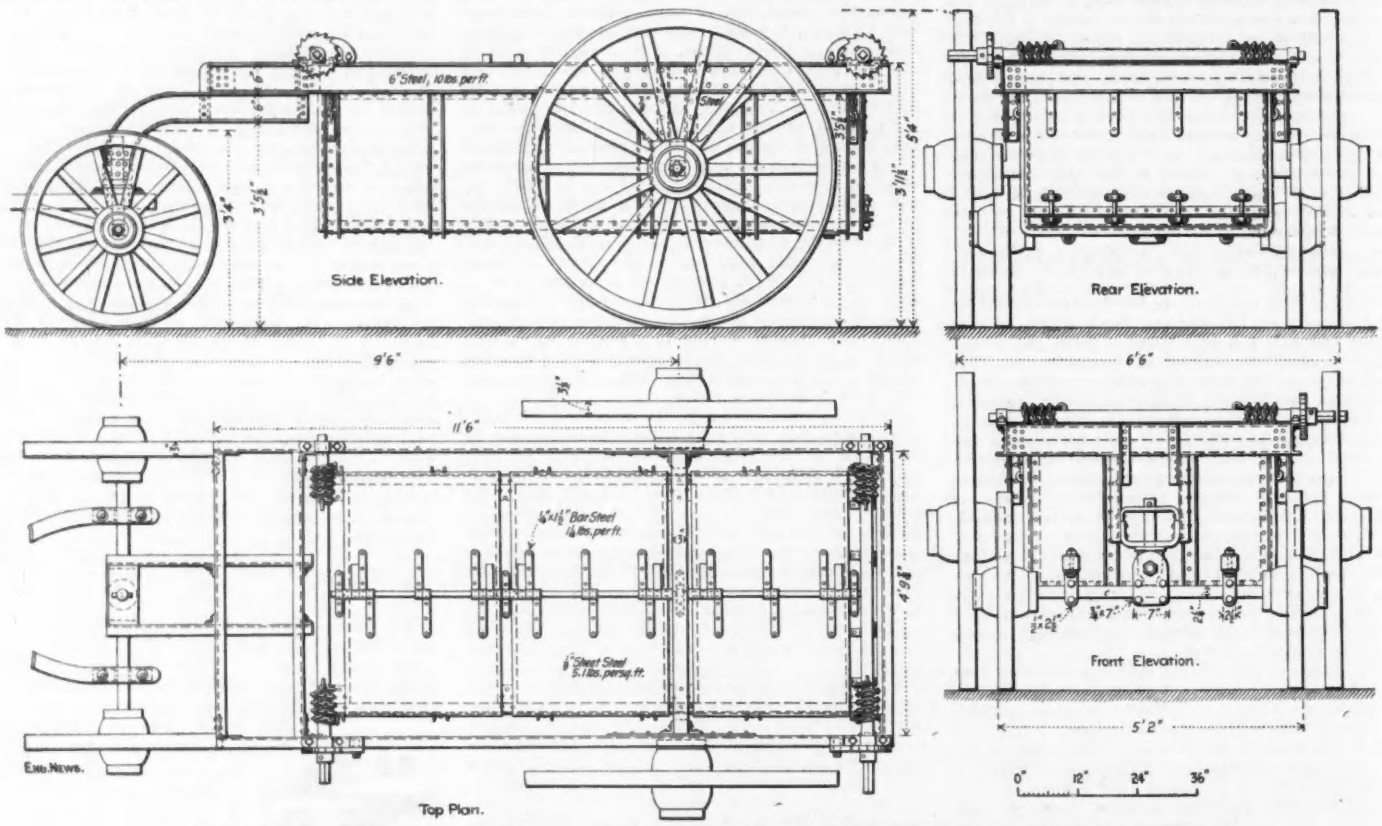
The principal advantages claimed by Mr. Allen for his design are that all the points of division are in the center of the rod, where they are less likely to be injured than they would be on the edge, and that the odd and even numbers are placed on opposite sides of the rod, assisting somewhat in correct and rapid reading. In reading the rod, the last number to be read always falls below the cross-wire. The figures denoting feet (shown shaded in the cut) are marked in red on the rod, the points facing it are set back from the center line and the angle opposite it has a larger opening than the angles opposite the figures denoting tenths.

An admirable feature of the rod is that it is equally adapted to long distance work or work where dispatch is more important than accuracy and to short distance work where all possible accuracy is desired. In the former case the observer ignores the small central divisions designating hundredths of feet. In the latter case he uses them. It will be noted that both the tenth and hundredth divisions conform to the general rule in rod graduation that the position of intersection of a horizontal and inclined line can be estimated more accurately than the position of intersection of the horizontal line and the vertical projection of the inclined line. It will be evident that the graduation shown is also admirably adapted for a self-reading leveling rod.

STEEL GARBAGE-COLLECTING WAGONS.

The garbage-collecting wagon here illustrated has lately been adopted for use in New Orleans, and 40 of them are now employed in that city. They are made by the New Orleans Agricultural Works, Mr. W. V. West, President, to whose courtesy we are indebted for the plans presented. The wagons were built for the Southern Chemical & Fertilizing Co., which has the franchise for collecting and utilizing the garbage of the city.

As shown, the frame of this wagon is made of steel with the tank suspended from this frame, or truck, easily detachable and interchangeable. The tank has a capacity of about 3 cu. yds. and is suspended at the four corners by simple windlasses and chains operated by two crank handles at the



STEEL GARBAGE COLLECTING WAGON, NEW ORLEANS, LA.; New Orleans Agricultural Works, Manufacturers.

ends. For the 40 wagons used there are 10 extra tanks; the purpose being to lower the full tank to the ground at the place of deposit; detach the chain-hooks and hoist up an empty tank. The shifting of teams and the delay at depot for unloading purposes are thus avoided.

These tanks are watertight, and about 3 ins. from the bottom is a perforated false bottom, which allows the liquid to drain through into the lower part, from which it is drawn off by means of a valve in the bottom of the rear end of the tank. The more solid garbage is thus left in a state ready for cremation or other disposal. The top of the tank is closed by six tight doors. The total weight of the frame and tank is about 4,000 lbs.

THE USE OF WATER-TUBE BOILERS IN THE NAVY.*

By Walter M. McFarland, Passed Assistant Engineer, U. S. N.

The advantages offered by coil boilers for naval vessels are: Reduction of weight of boiler and contained water, adaptation to very high pressures, safety against disastrous explosion, rapidity of raising steam, freedom from injury due to forced combustion and facility in renewal when worn out.

Against these advantages are to be set greater injury by corrosion and more care required in feeding.

As a matter of fact, if it were not for the trouble due to corrosion, there would be hardly anything to be said against the coil boiler, for the difficulty sometimes due to feeding is a matter of training of the attendants. A friend recently wrote me in regard to the boilers of the "Monterey," where each fireman has two Ward boilers and one cylindrical: "One feed pump can be made to supply both Ward and Scotch boiler in battery, but every chump who calls himself a water tender can't do it."

It is hardly necessary to elaborate the advantages but it may be remarked that the reduction of weight is the greatest. For the last ten years the demand on the designer of naval machinery for increased power on reduced weight has been growing stronger, and although forced draft does materially reduce the boiler weight, it has not been an unmixed blessing. When we reflect that coil boilers weigh less than half as much as cylindrical ones for the same power, and that they can be forced to any extent without danger of injury, we see how desirable the coil boiler becomes.

In 1886 a test of a Ward launch boiler was made by a Board of Naval Engineers, Mr. Ward having offered his boiler for test and agreed to defray the expenses, and this test showed excellent results, both as regards economy of evaporation and power for a given weight. Herreshoff boilers had been used in naval launches for some time, but they were not entirely satisfactory in every respect and had not been generally adopted. The test of the Ward boiler gave information of a type of boiler adapted to all the requirements of naval purposes, and in 1888 several of them were fitted to naval launches. Their success was very marked, and since that time no new boats have been built which have not been fitted with coil boilers, although other types besides the Ward have been used, a number of Towne boilers having been fitted, and also one or more each by Roberts and Almy. Our experience with the Ward boiler has been more extended than with any of the others, and I have heard a number of officers who have had experience with it in different portions of the globe testify uniformly to their entire satisfaction with it.

About 1888 the Navy Department made a contract with the Herreshoffs to build the "Cushing," and the design in every respect was left to them. At first it was the intention to use Herreshoff boilers, but subsequently that firm, having acquired the control of the Thorneycroft patents for this country, requested and obtained permission to use Thorneycroft boilers in the "Cushing." In the early part of 1890 the "Cushing" was tested officially, after having been given a number of private tests by the builders. The official test as well as the others were very satisfactory, and showed the boilers to fulfill the requirements of the case with great satisfaction. (See Isherwood in "Journal of the American Society of Naval Engineers," for 1892.)

In 1888 Engineer-in-Chief Melville of the Navy urged upon the Secretary the importance of experiments on a large scale, to determine the suitability of tubulous boilers for use as a part or all of the boiler power of our naval vessels, and in accordance with his recommendation the Secretary sent out an invitation to all the builders of coil boilers in this country, inviting them to submit plans and prices to meet specifications which had been prepared by the Department. Some 15 or 20 replies were received, and in 1889 an invitation was sent to the makers of those boilers which appeared adapted, asking them to suggest a time when they would be ready to have their boilers tried. Four of the firms, who had previously replied acknowledged the receipt of this letter, but only two of them actually submitted boilers for trial, Mr. William Cowles, and Mr. Charles Ward. A boiler made by each of these gentlemen was tested by a Board of Naval Engineers under the presidency of Chief Engineer Loring, and the report giving the results was published in the report of the Bureau of Steam Engineering for 1890. (See Eng. News, Aug. 29, 1891.)

As a result of this competitive test the boiler submitted by Mr. Ward was adjudged to have given the best performance, and in accordance with the terms of the proposition under which the tests were made, a contract was concluded with him for supplying boilers for the U. S. S. "Monterey," to furnish the steam for 4,200 HP. in triple-expansion engines. The trial of the "Monterey" took place in 1892, and the boilers gave a very good account of themselves, the engineer officers who attended the trial speaking in the highest terms of their creditable performance. The trial of the "Monterey" was not in every respect a complete success, because the horse power of the machinery fell slightly below that required by the contract, and in explanations as to the cause of this deficiency there was some difference of opinion. There was no means of telling certainly how much steam was supplied by each kind of boiler (there being two single-ended cylindrical fire-tubular boilers besides the four Ward boilers). The naval engineers who were present attributed the failure to attain the horse power to lack of skill on the part of the firemen, while I have understood that engineers connected with the Union Iron Works, who built the vessel and all the machinery except the Ward boilers, thought that the trouble was partly due to the coil boilers. They thought this was not due to any defect in the boilers themselves, but to the fact that their position in the ship was such that it was difficult to clean the fires and keep them in the best possible condition, and that on this account there was a falling off.

It is to be noted in connection with this trial that a very high air pressure was used at times, as much as 4 ins. of water, and although some leaky tubes were developed in the cylindrical boilers, the coil boilers showed no signs of injury in any respect, and after the trial were as tight as before.

This comprises the actual experience in use in our

* A paper read at a meeting of members of the American Society of Mechanical Engineers.

own navy up to date. The "Ericsson," a sister torpedo boat to the "Cushing," with a few changes, now building at the Iowa Iron Works, is to have Thorneycroft boilers, while four third-class torpedo boats for the "Maine" and the "Texas" are to have Mosher boilers.

In a design elaborated at the Bureau of Steam Engineering last year, coil boilers in connection with cylindrical are to be used in supplying a quadruple-expansion engine. The coil boilers will furnish steam at 250 lbs. to the high pressure cylinder, while the cylindrical boilers will supply steam of about 150 to 160 lbs. to the first receiver. The type of coil boilers to be used has not yet been settled, as it is the policy of the Department to permit the contractors to make the selection in the first instance subject to approval.

Last summer at the International Engineering Congress a paper was read on the subject of coil boilers in general by Mr. Ward, and in the discussion of that paper I remarked that it appeared to me that the most important question in connection with coil boilers was their longevity. Being composed entirely of tubes of small diameter and quite thin, it naturally follows that corrosion will be a very important factor in their usefulness. Mr. Ward has informed me personally that some of his boilers which have been used on Western rivers, and have never been exposed to the influence of salt water in any way, have already been in service for over ten years and are still in excellent condition. There are also some in use on yachts, I believe, which have had six or seven years' service, and the revenue cutter "Manhattan" has a boiler which was put in in 1888, I believe, and is still in good condition. The launch boilers that we have used in the navy have been satisfactory in respect to longevity, as none of them have as yet given out, except in an occasional tube here and there, which were easily repaired. The "Monterey," of course, has been too short a time in service to have any question of longevity raised. The boilers of the "Cushing" have now been built at least five years, and they are in excellent condition, and have shown no signs of pitting or other serious deterioration.

The question of corrosion assumes a somewhat different phase for coil boilers from the same phenomenon for shell boilers, because in the latter the tubes form a relatively secondary part of the boiler, while in the former they practically are the boiler; and, as has been repeatedly pointed out, a leaky tube in a shell boiler can be plugged while steam is up; but this cannot be done in the coil boiler. There is no reason why the tubes of a coil boiler should deteriorate any more rapidly than those of a shell boiler, and in many types they ought to last longer because thicker.

Mr. Ward has stated that one of his boilers built nearly 14 years ago has lost only one tube, while a number of other boilers have been in use for six or seven years and given no trouble. Mr. Roberts also states that the first of his boilers, built about 15 years ago, has never given any trouble from corrosion. It is probable, however, that most or all of these boilers have been carefully kept free from the deleterious action of salt water, although a good many of these boilers are fitted in yachts about New York.

I might, then, sum up our experience with coil boilers by saying that as regards lightness, rapidity of raising steam, safety against disastrous explosion and safety against injury by excessive forcing, they have given entire satisfaction.

The experiments on the Ward and Cowles boilers in competition, and those on the Thorneycroft boilers of the "Cushing" and the Ward boilers on the "Monterey" show conclusively that coil boilers will stand any amount of forcing without injury, as these were all subjected to air pressures of 2 ins. and over for long periods without a single leak being developed. We also made a severe test of a small Towne boiler at one of our navy yards by running it for several hours under forced draft, then hauling fires as quickly as possible and turning a stream of cold water on every part of the boiler from a hose, so as to get the full effect of sudden contraction. Not a leak developed anywhere.

In this connection it is worth noting that the Belleville boiler has been in use in the French navy for at least ten years, and the experience with it has apparently been so satisfactory as to lead the English Government to place an order for a set of these boilers for the large English cruisers "Powerful" and "Terrible," which are to have about 20,000 HP. each. The Belleville boiler differs very materially from the coil boilers invented in this country and all others invented abroad, in having its tubes of very large diameter and much thicker than those in any other coil boiler. The tubes are generally about 4 ins. in diameter, and the lower row are about ⅝ in. thick, and no tubes are less than 0.20 in. This undoubtedly accounts for the long life of these boilers, as it is manifest that a trifling bit of corrosion which would go clear through a thin tube will only affect these thick ones half as much, and will still leave them serviceable for a long time.

The great trouble with the Belleville boiler, compared with most other coil boilers, is its weight. We shall doubtless shortly have some valuable data in regard to this particular boiler from the experience with the fast express steamers on the great lakes, which are to be fitted with boilers of this type.

The number of coil boilers is almost legion, and every inventor brings out some change in his own type at frequent intervals. I presume it would be safe to say that nearly all that are designed with any regard to a good circulation will give good results, and such has certainly been our experience with those thus far used in our navy. It is curious to observe, however, how ideas change in regard to what is necessary to secure a good circulation. Mr. Ward has always claimed that you could put your down current almost anywhere if the feed went into it, and that, of necessity, if the water went up in some tubes it must come down in others. For a while Thornycroft, Mosher and some others provided down-cast pipes entirely outside the boiler, but they have now abandoned that plan.

Discussion.

Dr. Chas. E. Emery: As regards the Ward boiler, I put one of the early ones in the "Manhattan." The way to overcome the difficulties with that boiler were really studied out in that vessel. The grease from the engine had a very deleterious effect in getting on the joints and overheating them, so that the down-take (the central drum) bulged, and it is possible that there was so much heat at that point that the circulation reversed there and made a local circulation. At any rate, by simply putting fire brick around that drum, which was specified for the next boilers to be built for the revenue service, that difficulty was overcome, and then they were very careful about grease. There was never any trouble with circulation in the tubes, and no trouble with the joints, although they were made very roughly.

Mr. Boyd: Several years ago I was engineer at the Atlantic Works and we put into the yacht "Shearwater" the first Belleville boilers made in this country. Those boilers performed very successfully. One winter they went on a cruise to the Caribbean Sea, and for about three weeks they used only salt water. When the boiler was opened I went down and examined the tubes carefully. There was no deposit of salt and there were no apparent defects in the boiler whatever. The owner of the vessel, Mr. Forbes, built a yacht of about double the capacity and he put in two Belleville boilers, and then two small donkey boilers. Those boilers have been in use now three years, and so far as any internal or external examination can be made they are apparently as good as the day they were put in. We are so much interested in the subject in Boston that we are investigating it and probably will undertake the building of Belleville boilers there under the Belleville patents. From our experience, without going into detail at all, we think it possesses qualities that are not possessed by any other multi-tubular boilers. Nothing, I think, except the renewal of gaskets, has been expended on any of the boilers I speak of.

Mr. H. DeB. Parsons: I am a believer in the water-tube type of boiler, although my remarks would probably appear as if the water-tube type was not the best. Yacht boiler service is probably the hardest for the boilers of any marine service. The consequence is that water-tube boilers in a yacht do not usually last more than two years. I had a yacht under my charge which had a water-tube boiler of the Herreshoff pattern. The boiler lasted about two years and the third summer was replaced with a water-tube boiler of another design. This new boiler proved absolutely worthless. I condemned it after a trial on the ground that it was too small for the engine. I then advised the owner to put in a new type of Herreshoff boiler, the one with the manifold, and I had a specially large grate made. This boiler has been in the yacht now over two years and I have heard no complaints. In another case a yacht was furnished with a Ward boiler which wore out in about three or four years. The owner then put in four boilers of the Roberts' type, in place of the one large Ward boiler, against my wishes. The grate surface was increased from about 56 to 64 sq. ft. with four boilers. The result was that the fire-room was so hot you could not stay in it, and as the boilers backed up against the engine-room you could not stay in the engine-room. Further, the boilers could not furnish steam enough for the engine. The consequence was that the yacht was laid up all summer and never used. The boilers were put on the dock and replaced with the old Scotch boiler which I recommended originally. Although the grate surface is only 50 sq. ft., the Scotch boiler gave plenty of steam to run the engine. The result of my experience from these cases and others is that a water-tube boiler needs more grate surface than the Scotch type. I know they will stand forcing, according to the tests, but my experience does not indicate that they will give in ordinary practice the horse power per square foot of grate that you can get out of the old-fashioned boiler. The reason of that is probably that there is no storage of steam, no energy stored in hot water, and the consequence is when the steam pressure once runs down you cannot raise it again; the engine will take it faster than it is made unless you have boilers of ample size.

Mr. Kafer: The reason for adopting water-tube boilers has been the desire to economize in weight. The problem for the naval designer now is to get maximum power from minimum weight. If you have a water-tube boiler with sufficient grate surface, that alone will not accomplish the result. You must burn coal at a maximum rate of combustion. The great difficulty in the water-tube boiler is to get it perfectly accessible. With tubes readily removable repairs can be easily made, and the boiler should be made to last a reasonable length of time, which does not mean necessarily the length of time that a Scotch boiler will last.

I do not know of any boiler in the market which will fulfill all the conditions and yet have maximum power for minimum weight. The great difficulty with designers has been the attempt to crowd too many small tubes in the space allotted to them; and they do this because they want to get rid of the weight of water. The Belleville boiler is a very excellent boiler to operate under natural draft. But if you will take a box coil and build a hot fire under the lower coil and burn 50 lbs. of coal per sq. ft. of grate, you will find trouble before you get up to the upper end. That is one reason why a Belleville boiler will weigh about as much as or more than a Scotch boiler of the same horse power under forced draft. The Belleville boiler must be operated at a lower rate of combustion than that at which the Scotch boiler can operate with perfect safety.

With reference to the other types of boilers, Yarrow and Thornycroft and others, it is well known, I think, that a boiler of that type will hardly evaporate as much water per pound of coal under ordinary conditions as the Scotch boiler.

Mr. B. F. Isherwood: The principal merit of the water-tube boiler, of course, is the lighter weight. The vital defect about it, one which has been very little alluded to heretofore, if known at all, is that it is impossible to obtain with it the same economic evaporation that you can obtain with the ordinary shell boiler. That is to say, if you make the two boilers, the pipe boiler and the shell boiler, both with the same grate surface and the same heating surface, and burn the same quantity of coal in both per unit of time, it will be found that the pipe boiler gives about 10% less economic evaporation. The reason for this is the air leakage in the case of the water-tube boiler. In the case of the shell boiler no exterior air can get mingled with the gases of combustion. The only air that enters is what enters through the furnace. Every particle of air that enters into and mingles with the gases of combustion after they have passed over the bridge wall reduces the economic evaporation of the boiler very largely. In the first place, it cools those gases so that they do not have equal temperature to act on the heating surface, and consequently cannot give the evaporation; and in the second place, it requires a certain quantity of heat to force those gases out against the resistance of the atmosphere at the top of the chimney, which also is at the expense of the heat of the coal. The two things put together will make that difference about 10%, as I have stated, of the economic evaporation of the two types of boiler. There is no practical way of excluding the air leakage, and while I am on this subject I will say that there is just the same difference of 10% in boilers set in brickwork. You take the ordinary boiler with straight tubes and the shell and you set it in brickwork. You have a brick furnace. You will never get the same economic evaporation from it as with a shell boiler, that is the Scotch form of boiler, for the simple reason that there will percolate through the brickwork setting a certain quantity of air, very much larger than any one would suspect, and that reduces the economy of the evaporation. In the early days of my practice as an engineer I was confronted with the fact that all the boilers set in brick masonry gave a lower economic evaporation than those not so set. In other words, that the interior-fired boiler gave a higher evaporation than the exterior-fired boiler. I made quite a table of the results from all the boilers of the two types that I could obtain. A very great many of those experiments were made by me and I took the mean of them and I found that they approached the 10% very closely. I did not at that time know the reason. I had not the faintest idea of it. I thought it was something in the type of boiler. But really I could not reconcile it. I had the same grate surface, heating surface and combustion of coal in both cases. I could not see why this difference should

be for a long while. But the difference was there as a practical fact, and it was caused, as I afterwards ascertained, by what I have stated—the in-leakage of air into the gases of combustion, cooling them and requiring more expenditure of heat to expel them from the chimney.

Now let us see what in a ship a difference of 10% in the evaporation of the boiler means. To develop the same power for the same length of time you have got to carry 10% more coal in your bunkers. If you have a vessel which carries 1,000 tons of coal in its bunkers it has got to carry 1,100 tons if you replace the shell boiler with the pipe boiler. That difference of course becomes more important as you carry more and more coal, and make longer and longer voyages. That difference goes very far to counterbalance the saving of weight with the water-tube boiler. Of course upon the land where the weight is of no importance, you simply lose your 10% of fuel. But on a ship you not only lose that, as far as cost is concerned, but you have got to carry this extra weight, and if you do not carry it you have reduced the steaming radius of your vessel that much.

In addition to this in-leakage of air, the radiation from the water-tube boiler is very much greater than from the shell boiler. In the case of the shell boiler the temperature is that of the water inside of the boiler; that is the temperature which is on one side of the shell, the atmospheric temperature being upon the other. In the case of a water-tube boiler the temperature of the gases of combustion is upon one side of the shell or casing and the temperature of the atmosphere on the other. The radiant heat in a vessel with a water-tube boiler is intense compared with the radiant heat from the ordinary shell boiler. Those are facts that have to be met and we have to account for them in designing boilers. For small vessels, launches, torpedo boats, and that class of vessels, you have generally but one boiler and you have plenty of air circulation around it, where it can be kept clean and well cared for. If any repairs are to be made it can be hoisted out on the dock by a few men and put back again. But it is a very different thing when you put an enormous power into a vessel in boilers of this type. As a general rule they will probably last under ordinary circumstances of sea practice from two to three years. It is difficult to understand that they can last longer than that. I am aware that some boilers like the "Cushing's" and a few others have lasted much longer, but why? They have been protected by zinc. Large quantities of zinc have been put into them, according to the practice of the Thornycroft people and others building those boilers. That answers very well. But it is very expensive. The simple question is, Will you pay in zinc or will you pay in boiler? But you have got to pay for the thing one way or the other. Then there comes the difficulty of repairing. Any person who has examined those boilers and has seen the wilderness of small tubes in them, the impossibility of getting at any one of them or at their joints, will see that to repair one of those boilers you have got to lift it out as a general rule. You cannot find the defect. It may happen to be an outside tube, or an inside tube and you can see it then, but if it is any of the interior tubes that leaks it is impossible to tell. Now, it is a very serious piece of business to have your boilers break down all at once at sea. What is required is durability. That is a very important point. In the case of the ordinary Scotch boiler, in which iron tubes or steel tubes will last from two to three years, you can always see when your tubes are going. It is only a matter of eyesight, and they are easily replaced, as they are straight tubes. Your firemen can replace them with very little trouble. But it is a very different thing to repair a water-tube boiler in a large vessel, where you have to break all the connections, piping, everything, and actually lift the whole affair out, amounting to almost a reconstruction, each time you attempt to make extensive repairs. Of course these are facts which will probably develop as these boilers come more and more into use, and I have no doubt they will come into use, but not permanently. I have very great doubts of that for anything like seagoing vessels. But like all other physical subjects we must depend on practice and experience to test this.

The tubes of an ordinary tubular shell boiler will last from two to three years and there is no imaginable reason why they should last any longer in the water-tube boiler, if as long. The old Martin boilers, which we had in the Navy, had vertical water tubes placed in the tube box. When those tubes were made of iron the lower 6 to 9 ins. began to rust out in less than a year. You had to commence renewal at about that time and continue it constantly until they were all renewed. The upper part of the tube was not touched. They were as good as new. The lower part was entirely gone. Now why was it? Simply this: the lower portion of the tubes were surrounded by ashes, and every time the boilers were cooled down, there was a deposit of moisture on the surface of the tubes which trickled down into this ash and made a very corrosive alkaline solution which corroded the tubes very rapidly. Now why should not this result take place in, we will say, the Thornycroft boilers, in which the lower parts of the tubes are vertical? They are inaccessible for cleaning; the ash and soot must collect, and they must be damp at times and there must be the same alkaline solution there that there was in the Martin boiler, and why should it not produce the same effect of eating out the tubes? These are all matters which future experience will have to solve, but they are very important ones and lead us not to be too sanguine of the success of the new class of boilers.

With regard to the Belleville boiler, that was first used in the French Navy as far back as the days of Napoleon III. It was put, I think, in some half a dozen vessels, and I do not know that that type of boiler has been modified at all since. The boiler which was put in the "Shearwater" was exactly the same as was used in the earlier French vessels, and every one of them was taken out. A number of years ago I was in France and visited every French dockyard, and I conversed very freely with the French engineers stationed there. Their opinions to a man were against that type of boiler. They were all removed from the vessels. Since that time they have been re-introduced, and with what success it is impossible for me to say, because the most instructive facts respecting such trials rarely reach the world. I mean the failures. We hear all about the successes, but we hear nothing of the failures, and that is one of the great difficulties we have in engineering in getting at the correct state of facts. Nevertheless, I think that the Navy should make experiments on this type of boiler; they should build one of this type, try it thoroughly and stop at no expense on it, because the subject is well worth the cost. But thus far we have not had any such experiments, complete enough or extensive enough to enable us to form a real opinion upon it.

As regards the forcing of a water-tube boiler, it can be forced to any extent from the simple fact that the tubes are curved, so that any difference of expansion does not injure the joints, and the tube merely curves more or straightens more, but the joint remains unaffected, nor is the tube at all injured. In the Scotch boiler we have a straight rigid tube, and whenever the temperature of that tube becomes much greater than the temperature of the water which surrounds it, it is sure to expand and force the tube ends through the tube plates. That has always been the result when the attempt is made to force combustion in a vertical Scotch boiler beyond 46 or 47 lbs. of coal per sq. ft. of grate per hour. That is the maximum combustion that is possible with it.

In the British Navy the attempt was made to go beyond that, and as all the world knows it was a failure. The boilers leaked a deluge the moment that rate of combustion was passed. Then it was stated that by means of a species of ferrules they had succeeded in overcoming that difficulty. Well, that was one of the little romances that are sometimes used to cover a failure. The truth is the so-called ferrules did no good whatever, and the proof of it was the fact that they were obliged to lessen the rate of combustion down to a point somewhere in the neighborhood of 40 to 45 lbs., which is now the maximum and at which those boilers are perfectly safe, but not above that.

Now these are about all the facts we have to go on, and what we want now are careful experiments made by competent people here in America, where we know the persons and can witness the process. The subject is a very important one indeed and I would be the last one to throw cold water upon it. Still I think the chances of ultimate success are much better when all the difficulties are known in advance and can be calmly and deliberately provided against.

Mr. Eckley B. Coxe: I want to ask what effect the increasing or decreasing the amount of coal consumed per square foot of grate surface has on the temperature of escaping gases, and upon the proportions of the carbonic oxide and the free oxygen. From experiments I have made lately I am satisfied that a great many of the wonderful divergences that are found in experiments on boilers are due to the fact that that relation between the free oxygen and the carbonic acid and carbonic oxide varies very considerably. I have recently in an experiment had as high as 15% carbonic acid and no carbonic oxide. I have also had as much as about 9% carbonic acid, 8% of free oxygen and still nearly 2% of carbonic oxide. Now it is not necessary to tell anybody that that means a good deal of difference in evaporation.

Mr. Isherwood: The relation of the different gases of combustion depends altogether on the thickness of the bed of coal upon the grate surface. If the thickness of the bed of coal is not more than 12 ins. or less than 6 ins., it will be found that there is practically a perfect combustion, with coal of the ordinary lump size, and that just twice the quantity of oxygen or atmospheric air has been supplied that is chemically required. Now if you will simply increase the depth of the coal on the grate bars, you can have any proportion between carbonic acid, carbonic oxide, unconsumed air and free oxygen that you like. If you will make sufficient depth you will get the ordinary gasogen in which nearly the whole of the carbon of the coal is converted into carbonic oxide. The temperature of combustion is entirely independent of its rapidity. The temperature of all fires at the surface of the coal is exactly the same. Good firing consists in knowing what the limits of thickness for the bed of fuel are and keeping within them. Some particular fireman or some particular watch of firemen do a great deal better than others. They carry the same steam with very much less fuel and if you watch them you will find the reason very easily. They have found out by practice the exact thickness of the bed of coal, which gives them the maximum result and they adhere to that. Other firemen, less observing, do not know that and violate the rule, and of course make a great deal of carbonic oxide and lose a great deal of the economic effect.

Mr. McBride: I find that the amount of carbonic acid gas, carbonic oxide and oxygen can be varied to almost any extent you want by increasing or decreasing the amount of air admitted to the ash-pit.

Mr. Forney: I should like to inquire if anyone present has any data with reference to the water capacity of water-tube boilers in proportion to the quantity of fuel consumed. It has seemed to me from the general drift of the papers on this subject that some difficulty in the operation of water-tube boilers was experienced from the fact that the water capacity of the boiler was so extremely small in proportion to the old-fashioned shell boiler, and that naturally led me backward to the experience in locomotives which, as you know, years ago were of small dimensions, and as traffic and business increased, the demands upon the locomotives increased in somewhat like proportions, but the size of the boilers unfortunately did not. I think it has been proved a great many times in locomotive practice that the increased water capacity is a decided advantage in the operation of the locomotive and the boiler.

Mr. Almy: I would say in regard to the weight of water in an Almy boiler which has been in use some three years, that the weight of water is about 1¾ lbs. per sq. ft. of heating surface. This boiler develops 272 I. HP. on 3¼ ins. air pressure and weighs about 5½ tons. There is no trouble to maintain the water level in it and carry a steady steam pressure. It runs with about 225 lbs. steam pressure, and it has been run with 250 lbs. I have one boiler which I built 4½ years ago that weighed 6,500 lbs. and carries 1,400 lbs. of water. That boiler has run about 75,000 miles, developing 140 I. HP., and it shows an economy over a tubular boiler of 13% in 4½ years. In regard to the heat of the outside casing, the temperature is about 120° F.

Professor Hutton: Some years ago Prof. W. P. Trowbridge, of Columbia College, designed a spiral coil boiler with a forced circulation. The feed pump was also a circulating pump, so that the water which was to be evaporated was kept continuously circulated in the evaporating coil and was delivered from the top of that coil into a little bit of a steam space from which the engine took its supply. As a result of the design, and that feature of forced circulation, a boiler which you could cover with a flour barrel was competent to run a 40-ft. launch. Professor Richards, of Sheffield, made an elaborate investigation of that boiler. It was the aim to supply the demand for a boiler which should be practically self-managing; that would require no more attention from anybody than a base-burning stove. You filled it in the morning and you filled a magazine of water, and it was to be self-feeding and keep its level constant until somebody thought of looking at it again, with the idea that in printing offices and other places in the country such a thing would be useful.

Mr. Mosher: The bad reputation that a great many water-tube boilers have is due, I think, to their not being adapted to the work intended. Take an ordinary cylinder boiler, or even an ordinary kettle on a stove; if not forced too hard it gives very satisfactory results. If you attempt to drive it very hard, you then have to provide some further means for circulation, or you drive the water all out of it. Now, as regards economy in a boiler, if the conditions are such as to admit of perfect or nearly perfect combustion, it matters not what sort of boiler you use, provided you supply sufficient heating surface to absorb the heat, so that the temperatures admitted to the stack are very low. As regards the economy of the water-tube boiler compared to the shell boiler, the absorption of the heat should be equal in either case, providing you have an equal amount of water-covered surface, and the economy should be equal. As regards air leaking in through the casing, that is purely a question of workmanship, and I consider that there is no excuse for it. It is an undoubted fact that very few boilers are thoroughly protected to check radiation. As regards burning

from 30 to 50 or 100 lbs. of coal per sq. ft. of grate, the boiler has got to be adapted to it or there will be a failure, and many boilers are driven beyond the rate for which they are adapted. For instance, the Belleville boiler gives very satisfactory results under natural draft. One of the reasons it will not stand forcing is because the tubes have a very small incline. Again, the boiler that has only a very small quantity of water has got to make the steam as fast as it uses it. The fire has got to be fed very lightly, for the steam will come and go as the fire door is opened; whereas with a boiler carrying a large amount of water they can put on a large amount of coal at a time, and the effect is not realized. I think one of the reasons why Mr. Belleville has resorted to such large diameters of tubes is the very small incline of the tubes. It is stated that in many of our stationary boilers you see tubes set at an angle of 15°. When burning 20 lbs. of coal per sq. ft. of grate the water is driven out of the lower tube next the fire. To correct that, it is only necessary to set the tube at a greater incline and provide sufficient circulating water.

As regards the deterioration of the water-tube boiler there seems to be no fair reason why it should deteriorate any quicker than a shell boiler. No doubt you have all heard of the steam yacht "Norwood." It was supplied with a water-tube boiler, and the tubes lasted something over three years. In that boat high speed was the main object and the matter of saving weight was of by far the greatest importance. I made use of very thin solid-drawn steel tubes (No. 16 gage). This boiler was run a large portion of the time in salt water, yet the tubes lasted over three years before they gave out, through pitting, and they all showed signs of pitting about the same time.

As regards plugging or replacing the tubes in a water tube boiler, boilers with crooked tubes generally are so arranged that replacing the tubes is a difficult matter, but they may be plugged very handily. In a boiler recently designed I have provided two independent boilers in a single casing, so that in case one side should give out you could continue with the other side. I think on small launches that is quite an important matter, as I have known some that have had accidents on the ocean and very narrow escapes.

THE WELSBACH INCANDESCENT GAS BURNER FOR ARTIFICIAL GAS.*

By J. W. R. Cline.

About the year 1880, Carl Auer, then a pupil of Prof. Bunsen, at the University of Heidelberg, became interested in the subject of illumination. Bunsen particularly impressed upon the mind of Auer that the present method of obtaining illumination from the combustion of gas in the ordinary way, in which the separated carbon particles are made incandescent through the heat produced by the combustion of the hydrogen, was far from being economical, inasmuch as the amount of light yielded was but a small percentage of the energy contained in the gas, and gave it as his opinion that the light of the future would be obtained by first converting the illuminating gas into a heating flame, through the medium of the well-known burner bearing his name, and then applying the heat so produced as to bring to incandescence some refractory material. Young Auer revolved this suggestion in his mind, but before he had succeeded in obtaining any practical result, the electric light changed the current of his thoughts.

As is well known, in order to produce the incandescent electric light, it is necessary that the carbon filament be used in a vacuum. He saw the expensiveness of this method, and began a series of experiments to produce a filament made from refractory earths or oxides that could be used in the open air without being consumed. It was while engaged upon experiments of this nature that he produced his most wonderful burner.

Substantially, the burner consists of a cylinder of network suspended from a wire over the exit of a Bunsen burner. This cylindrical network is made by first weaving fine cotton thread into the shape desired. It is then dipped to the point of complete saturation in the chemical solution of the oxides of zirconium, lanthanum, thorium, yttrium, or certain other metals; then attaching the mantle by a platinum wire, threaded through one end to a vertical wire bent at the top into a horizontal loop. A flame is then applied and the cotton entirely burnt out, leaving in its place the oxides of the metals, which are almost absolutely indestructible by fire, and reproduce in every detail the form and texture of the destroyed cotton. The wire supporting this mantle is then set into a gallery attached to the burner, similar to the gallery of an Argand burner, and thereby held over the exit of the gas. The gas, as it issues from the Bunsen burner, burns only with a blue flame, but, impinging directly upon the mantle, heats it sufficiently to render it incandescent, producing a perfectly steady and clear column of light, about 3 ins. high and 1 in. in diameter, which may be made almost as white as daylight, or as yellow as the light of an oil lamp, as desired. It is claimed that a perfect combustion of the gas is obtained, and the vitiation of the atmosphere, which always accompanies the present method of gas lighting, is absolutely avoided. This burner produces at the least calculation four times as much light as the ordinary gas burner, consuming the same amount of gas. This is shown by tests made and certified to by such eminent experts as Dr. Ford, U. S. Inspector of Gas and Meters, Washington, D. C.; Wm. Wallace, Public Analyst and Gas Examiner for the city of Glasgow; Conrad W. Cooke, member of the Council of the Physical Society, London, and others. All of whom find at least 20 c. p. to the foot of gas consumed by this burner.

(Tests of the Auer, or as it is more commonly called, Welsbach, burner were made by the General Manager of the Continental Gas Co., of Dessau, Germany, and were published in the transactions of the "Vereine zur Forderung des Sewerbefleisses," and in "Light, Heat and Power," (Phila.) for February, 1894. With a pressure of 40 mm. and a consumption of 110 liters per hour an Auer burner gave 74 c. p. At the same pressure an ordinary slit burner gave only 13.5 c. p., burning 150 liters per hour. The efficiency of the Welsbach burner decreases with age, however, falling off some 22% after 500 hours' burning, and some 44% at the end of 800 hours. The average life of the burner is from 500 to 800 hours, but burners frequently last for 2,000 hours or longer.—Ed.)

* From a paper read before the Ohio Gas Light Association.

BUILDING STONE ROADS IN COUNTRY TOWNS.

A recent number of "Good Roads" contains an article on the cost to a town or county of building a good, substantial stone road on the "home-made" plan, prepared from data furnished by the American Road Machine Co., of Kennett Square, Pa. We abstract this, as follows:

When the town is well supplied with improved machinery and the stone can be procured free of cost and in close proximity to the point of use, the cost is put down as follows: With 6 ins. of unscreened road metal a road from 10 to 12 ft. wide can be built at from $1,000 to $1,200 per mile; if the road metal is screened the cost will be increased by about $200 per mile.

In Pennsylvania, in a certain town taken as an example, the assessed road tax amounts to about $5,000 per year, and with this amount a little over 100 miles of road is to be kept in repair. Assuming that the town is supplied with road graders and other machinery, it will require from $1,500 to $2,000 to keep the dirt roads in good passable condition. To cover the cost of building and repairing culverts, providing means for draining off surface water, etc., about $500 more is required. This latter, of course, does not provide for exceptional floods or excessive snowfalls. But in ordinary seasons this would leave about $2,500 on hand for stone road construction.

The first year nearly the whole of this balance will be consumed in buying a crusher, elevator, roller and engine; though some small towns may deem it best to hire these tools. After the outfit is paid for, about three miles of good, durable road can be constructed each year, and the beginning is made, small though it appears. Of the 100 miles, about one-half only will need macadamizing, the balance being unimportant roads not used to any large extent in bad weather. To pave the 50 miles of roads would thus seemingly take about 17 years. But, as every year there are fewer dirt roads to take care of, the time of execution will be really shorter; and good roads will attract a better class of residents, and money can be usually raised by subscription under these circumstances.

This advice should be taken, however, with the caution that all the roads must be maintained, and our contemporary does not go into the question of the extra cost of this maintenance on the stone roads built. The expense of maintaining a substantially built stone road, 10 to 12 ft. wide, and under a light traffic, would probably not exceed the amount of money usually spent upon a dirt road, under present wasteful methods. But if the traffic is heavy the stone road would cost more to keep it even in "good, passable condition," and there would be that much less money each year to expend upon new roads. It is very much a question of the amount of traffic over the roads to be first improved, and in figuring upon the problem with the data here presented this question of traffic must be carefully considered.

THE APPOINTMENT OF CITY ENGINEERS IN KENTUCKY.

The State of Kentucky recently passed a law regulating the method of appointing city engineers in cities of the first class, as follows: The Board of Public Works is given the power to appoint a chief engineer and such subordinates as may be deemed necessary. But it is provided that all applicants for the position of chief engineer shall first be examined by a board of three competent civil engineers selected by the General Council. Only those who pass this examination are eligible to appointment. In cases where the examination is made in writing, all papers used therein must be filed as public records with the Secretary of the Board of Public Works.

The General Council fixes the compensation of the examining board; but it is also provided that no civil engineer, except the chief engineer, employed in his professional capacity, shall receive more than $1,500 per annum as a salary. The law somewhat vaguely implies that both chief and subordinates can be removed or punished by the Board of Public Works, with the cause stated in writing, as is prescribed by ordinance. No officer or employee can be removed for political cause; but interference in elections, or canvassing by any officer shall be cause for instant removal.

Some Kentucky engineers object to the examination clause on the ground that an engineer selected for so responsible a position should be sufficiently well known and have a sufficient standing to make this test unnecessary; a test which is not applied to second or third-rate lawyers in legal practice. To this it may be answered that while this examination is in a sense humiliating professionally, the well-equipped and trained engineer need not fear it as long as the examination is fairly conducted by competent engineers; and the non-engineering Board of Public Works is thus fairly well insured against incompetency in an important office. Except by public rumor this board is not fitted to decide upon the technical fitness of an applicant, and hence it delegates this choice to those who should know. As far as the comparison with the non-test of second-rate lawyers is concerned, it should be remembered that an incompetent city engineer can do much more public mischief than is possible to the fledgling lawyers, and the test for fitness is much more necessary in one case than in the other if there is to be any test at all.

FAILURE OF A MASONRY AND A ROCK FOUNDATION.*

By W. B. Parsons.

About 15 miles east of Hornellsville, N. Y., on the Central New York & Western R. R., there is an iron viaduct, 700 ft. long and 235 ft. high, built in 1883. The tallest tower has two of its legs resting on piers, which stand in the bed of the stream. About five years ago these piers were found to be badly cracked and were encased in a jacket of concrete, 12 ins. thick, but cracks continued to appear, and an investigation was made by the writer in 1893. One crack, 4 ins. wide, extended from top to bottom, a height of 10 ft. The bottom and sides of the glen in which the pier was placed consisted of shale rock of various degrees of hardness. The concrete coating had been put on the piers down to and resting on the top surface of the shale, and this was badly eaten out so as to produce settlement and cracks.

The first effort was to save the pier and concrete by excavating a trench in the rock around it, which was to be filled with concrete, but the jar in excavating brought down a large piece of the concrete jacket and showed the whole pier to be in an unsafe condition. The shale had decomposed underneath the pier, and an attempt had been made to shovel gravel underneath it. The stones composing the masonry were poor, and every stone was more or less cracked. To support the tower during the removal of the pier, small plate girders, 5 ft. long and 30 ins. deep, were built, and fastened with turned bolts to the leg of the viaduct. The projecting ends of these rested on four 20-in. I-beams,

* Abstract (from Society's bulletin) of a paper read before the American Society of Civil Engineers, May 16.

18 ft. long, supported at their ends by cross-timbers, resting on three 30-ton hydraulic jacks at each end. Stout cribs of old bridge timber were built to receive the jacks, and made V-shaped up stream, to render them safe in case of high water.

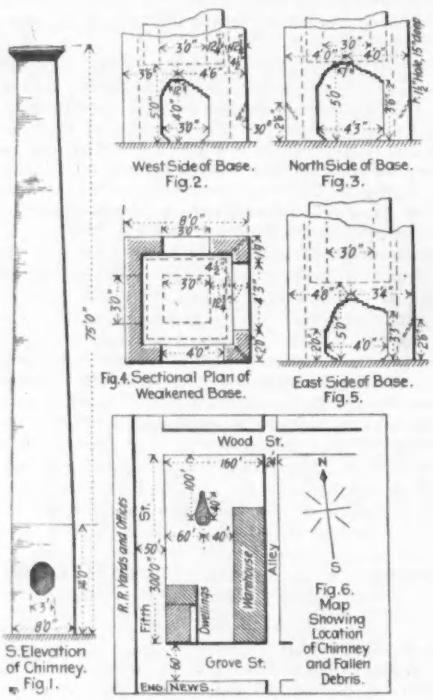
As soon as the iron was removed clear of the pier, the masonry was removed, and it was found to be in a very bad condition. The vertical face joints, in many cases, were but 1-in. deep, the stones being triangularly shaped, with the bases outward. All was easily removed with a bar and shovel. In making the repairs, the shale rock was excavated for 3 ft. in depth, and 3 ft. outside of the lines of the new pier. It was laid up in Leroy limestone, which is hard and durable. The stones were carefully cut, with full joints, so that very little backing was required. The only difficulty in the work was in putting in the holding-down bolts. To do this, the bolts were placed through the pedestal stones from below, and the stone held up in place while the masonry underneath it was built up to it. The coping stones were so laid out as to have the bolts pass through the joints. The cost of doing the work was $1,042.

RAZING A CHIMNEY WITH DYNAMITE.

By Robt. A. Cummings, Assoc. M. Am. Soc. C. E.

The subject of this "memoir" was encountered in the construction of the Columbus Connecting & Terminal Railroad, in the City of Columbus, O. The engineer leading the march of construction had surmounted greater obstructions than this bold obstacle, but the close surroundings and necessity for quick work made the problem more interesting.

The chimney in question was used by a large



Razing a Chimney With Dynamite.

bent wood and buggy-wheel factory, and was located very close to some of the buildings it was desired to preserve. It was built wholly of brickwork, with ordinary bricks on a rubble masonry foundation, the horizontal cross-section being square, and the height above foundation 75 ft. From the base to a height of 14 ft. it was 8 ft. square outside, from which it tapered to about 5 ft. square under the projecting courses at the top. A 4½-in. air space divided the walls of the chimney into an inner and outer shell. The two shells were bonded together by staggered bricks every sixth course. The cap was made of four heavy pieces of cast iron, bolted together and bolted down to the brickwork.

The proximity of the streets and buildings made it inadvisable to pull it over bodily, and the risks from other sources were also too great. Many schemes were canvassed for doing the work. It was even seriously proposed to erect a scaffold and take it down brick by brick. This was abandoned, however, as being too expensive and slow, the saving of bricks being inappreciable in comparison with the saving of time. The method finally determined upon was to raze it suddenly, preventing a scattering of the debris by carefully cutting away part of the base and "blowing out" two supports. It was expected that the chimney would collapse into a heap of bricks and fall toward the north as desired, and this was quite successfully accomplished.

Fig. 1 is an elevation of the south side of the chimney, showing an old flue hole. Figs. 2, 3 and 5 are elevations of part of the base from the west, north and east, respectively. Fig. 4 is a plan of the base. Fig. 6 is a plan showing the location of the chimney and the lozenge-shaped extent of the debris after the fall. At the northeast and northwest corners two 1½-in. holes were drilled downward, at an angle of 60° with the horizon, and 18 ins. deep, the holes starting 2 ft. 6 ins. above the foundation. At the same time the base was cut away through to the flue on the north, east and west sides, as shown in Figs. 2, 3 and 5. The base of the inner shell was entirely cut away, leaving it to be supported by the outer shell, through the staggered bond bricks. Several feet above the base on the south side an old hole 3×4 ft. (Fig. 1) had been cut through to the flue, apparently for the old boiler flues; this was considered sufficiently weakening for the south side and was left as found.

Half a cartridge of low-grade dynamite connected with fuse wires was placed in each of the holes at the northeast and northwest corners. The fuse wires were of equal lengths, and were threaded through a cribwork of old crossties, closely stacked around the chimney to stop any flying debris. The two fuse wires were lighted simultaneously and the explosions seemingly produced but one report. The supports were blown away and the chimney fell toward the north, having the appearance in falling of being compressed along its vertical axis. The mass of brickwork was heaped within a short radius. The center of the top casting, which was the farthest away of any of the debris, was found 40 ft. from the center of the chimney.

Estimating the original weight of the chimney at 185 tons, the actual load per sq. ft. of base was 3.63 tons, which was increased to 10.6 tons per sq. ft. by the cutting away of the brickwork. The bricks cleaned and stacked for future use represented approximately 84% of the total number in the chimney.

PERSONALS.

Mr. D. A. Reed has been elected City Engineer of Duluth, Minn.

Mr. Frederick T. Crane has been appointed City Engineer of Orange, N. J.

Mr. Abram J. Hardenbergh, railway contractor, of Port Jervis, N. Y., died May 7, at the age of 64.

Mr. J. H. Winder has been appointed General Manager of the Seaboard Air Line, vice Mr. L. T. Myers, resigned.

Mr. E. W. Smith has been appointed resident engineer to superintend the construction of the water-works at Danville, Ky.

Mr. G. J. Grammer, formerly President of the Evansville & Terre Haute Ry., has been appointed General Manager of the Chesapeake, Ohio & Southwestern Ry.

Mr. Charles E. Webster, Acting Chief Engineer of the Lehigh Valley R. R., has been given the full title of Chief Engineer. His office is at South Bethlehem, Pa.

Col. Joseph Moore, who planned and built the pontoon bridges used by General Sherman on his march "from Atlanta to the sea," died at Indianapolis, Ind., recently, at the age of 65.

Mr. S. O. Wood, Consulting Engineer, of Los Angeles, Cal., has been engaged by J. B. Parker & Co., Los Angeles, Cal., as Chief Engineer of their patent water, sewer and gaspipe works.

Mr. Lewis B. Sebring, C. E., has been lately elected City Engineer of Schenectady, N. Y., to succeed D. C. Smith, C. E., who has been appointed as Resident Engineer on the New York State Canals.

Major John W. Powell has resigned his position as Director of the U. S. Geological Survey, and Mr. Charles D. Walcott, Chief Geologist, has been appointed his successor. Major Powell had held the position for 13 years and resigned on account of ill-health.

Mr. Ernest Flagg, of New York city, is the successful architect in the competition for a Capitol building for the State of Washington. The total number of designs submitted in the competition was 187. The estimated cost of the building is $1.000,000.

Mr. Walter T. Randall, of Syracuse, has been chosen Chief Engineer by the Board of Water Commissioners of Penn Yan, N. Y., and plans are to be made at once. By mistake it was stated last week that he had been chosen Chief Engineer of the Syracuse, N. Y., works.

Mr. Henry F. Baldwin has resigned his position as Chief Engineer of the Chicago & Eastern Illinois R. R,, to accept that of Chief Engineer of the Chicago, Peoria & St. Louis R. R., with headquarters at Springfield, Ill. Mr. William S. Dawley, formerly Assistant Engineer, has been appointed successor to Mr. Baldwin.

Dr. William T. Barnard, who died at Washington, D. C., May 9, was for nine years assistant to Mr. Robert Garrett, President of the Baltimore & Ohio R. R. He was the projector and first President of the Chicago & South Side Elevated Ry., the first elevated railway in Chicago, and in 1890 became president of the United States Aluminum Co., of New York.

Mr. Theodore Voorhees has resigned his position as General Manager of the Lehigh Valley R. R., and his duties will be performed by Mr. Rollin H. Wilbur, General Superintendent. Mr. Voorhees retains his position as Vice-President of the Philadelphia & Reading R. R., and will give all his time to that road, being at the head of the operating department.

Capt. Charles C. Morrison, U. S. A., of the Ordnance Corps, died at Governor's Island, New York harbor, May 13, of appendicitis. He was born in Ohio in 1849 and graduated at West Point in 1871. From 1880 to 1883 he was assistant at the Springfield Armory. He was then stationed at the Midvale Steel Works, Pennsylvania, and from there transferred to Governor's Island. Of late he had been actively engaged in the tests of guns and armor plate at Sandy Hook.

Mr. Joseph Tomlinson, Past President of the Institution of Mechanical Engineers (England) died recently at the age of 72. He had held positions in the motive power department of the London & Southwestern Ry. and London & Northwestern Ry., after which he was Chief Assistant Engineer of the Midland Ry., and Locomotive Superintendent of the Taff Vale Ry. and the Metropolitan Ry. He then opened an office in London as a consulting engineer. When the Taff Vale Ry. was extensively reorganized some three years ago, owing to complaints of mismanagement, Mr. Tomlinson, in conjunction with Mr. Swarbrick, was appointed to inquire into and report upon the general working of the line and subsequently accepted a position on the Board of Directors.

NEW PUBLICATIONS.

TABLES OF MOMENTS OF INERTIA AND SQUARES OF RADII OF GYRATION; supplemented by others on the Ultimate and Safe Strength of Wrought Iron Columns, Safe Strength of Timber Beams and Constants for readily obtaining the Shearing Stresses, Reactions and Bending Moments in Swing Bridges. By Frank C. Osborn, C. E., M. Am. Soc. C. E., etc. New York: Engineering News Publishing Co. 4th Ed.; 12mo.; pp. 175; $3.

This fourth edition of this work has been materially enlarged chiefly by the addition of 42 pages of tabular and other matter in respect to swing bridges, by means of which the labor of proportioning such structures is greatly reduced. This is by no means all the additions, however, as the variety of built sections tabulated has been extended by many hundreds, and now includes nearly everything that is likely to be required in ordinary use. It is needless to say that the work as thus enlarged fills a real void in bridge literature. Handbooks giving the properties of all sorts of rolled sections are common enough, but this work still remains the only one giving the properties of any considerable number of built sections, and a great deal of worse than useless labor (since it carries with it liabilities to error) is thus avoided. Built sections have now to so large an extent settled down to a few hundred standard forms that there is something absurd in hundreds of bridge men computing over and over the properties of built sections consisting of six to ten different elements, when they can just as well be tabulated once for all and taken direct from these tables. Mr. Osborn has with much labor done this work for the benefit of the profession, and to the best of our knowledge and belief with extreme care and accuracy, so that the tables can be relied on. We do not see how any engineer, engaged in bridge designing, or any one who hopes to undertake that work can afford to be without these tables.

BRIDGE SPECIFICATIONS; BALTIMORE & OHIO R. R.—By W. T. Manning, Chief Engineer, and J. E. Greiner, Engineer of Bridges. 8vo; pp. 23.

These specifications are the company's standard revised specifications for bridges and viaducts, dated 1894, and are a decided departure from the old B. & O. R. R. specifications. Soft and medium steel has been adopted to the exclusion of wrought iron; and the unit

stresses are determined from the ratio of the minimum to the maximum stresses. The sub-divisions of the specifications are somewhat different from those ordinarily used, and are considered a great improvement. Considerable attention is paid to general and detail designs, and red lead paint is adopted as a standard. Certain details, including adjustable members and continuous girders (except for drawbridges), are specified as not acceptable and minimum sections are specified for channels, angles, etc. The bridges are to be designed for a load of two typical consolidation engines weighing (with tenders), 125 tons each, followed by a train load of 4,000 lbs. per lin. ft.

OHIO STATE BOARD OF HEALTH: Report for the Year Ending Oct. 31, 1892. C. O. Probst, M. D., Secretary, Columbus, O. 8vo; pp. 391; tables.

The reports from local boards of health, now included in many of the state reports, are too often a woful commentary on the lack of the simplest sanitary precautions in hundreds of communities. The local reports in this volume show that advances in local sanitation are being made in Ohio. Among the papers printed in this report, the following may be mentioned: "The Soil in Its Relation to Health," and "Water Supplies as Carriers of Cholera," by Edward T. Nelson; "Cremation of Night Soil and Garbage," by Dr. M. M. Carothers; "The Destruction of the Waste of Cities and Towns by Fire," by Col. W. F. Morse.

NEW JERSEY STATE BOARD OF HEALTH: Report for 1892-3. E. M. Hunt, M. D., Secretary, Trenton, N. J. 8vo, paper; pp. 612; tables and illustrations.

Aside from the general report of the secretary, the reports of the local health boards, many of which show marked progress in sanitation, and the figures and discussion of vital statistics, this volume contains a number of papers, several of which are of engineering interest, as follows: An illustrated description of the sewerage system at Freehold, N. J., with land purification, written by Col. Geo. E. Waring, Jr., M. Inst. C. E. "The Interest of the State to Preserve Its Streams," by Carroll P. Bassett, M. Am. Soc. C. E.; "Surface Contamination of Water Supplies," by Chas. Lehlbach, Clark Hunt and A. Woodward, with a prefatory note by the secretary, and "The Disposal of Garbage," by T. R. Chambers. Aside from the subjects specifically mentioned, the report contains much matter of value to all persons interested in sanitation.

CONNECTICUT STATE BOARD OF HEALTH: Report for 1892-3. Chas. A. Lindsley, M. D., Secretary. New Haven. 8vo, paper; pp. 194 + 28 in appendix; also Registration Report, pp. 196; tables and diagrams.

A valuable feature of recent reports of this board is missed from the present volume, namely, the results of the sanitary investigation of the rivers and natural waters of the state. The omission was caused by the failure of the legislature for two years to make appropriations for the investigations, but, fortunately, the appropriation has been secured and the work is being carried on under the direction of Prof. H. E. Smith, of New Haven, Chemist to the board. Quite elaborate tables and some interesting diagrams are presented in connection with the report on vital statistics. Many of the reports from local boards show the need of improved water supplies and methods of sewage disposal, as do the local reports of other states.

USES OF COMPRESSED AIR.—By Addison C. Rand, New York, Republic Press. 12mo; cloth; pp. 134; illustrated; $1.

It is probable that most readers of this book will be surprised at the great number and variety of uses to which compressed air has been applied, including railway brakes and signals; drills, cranes and other tools, balloons, locomotives, etc., and for firing projectiles, mixing nitro-glycerine and refining asphalt, filling wheel tires, cleaning car cushions, power transmission, etc., etc. No attempt has been made to discuss the principles of air compression or the construction of the compressors, but to show the various applications of the compressed air. The book is handsomely printed, and is profusely illustrated, many of the cuts being half-tones.

THE POLITICAL ECONOMY OF NATURAL LAW. By Henry Wood. Boston: Lee & Shepard. 12mo, cloth; pp. 305; $1.25.

This little book reminds us of another work in a different field, in that the author has become so enamored of what he calls "Natural law" that he attempts to apply it to things with which it has nothing whatever to do. Because the survival of the fittest is the rule in the animal world, it does not follow necessarily that absolute and unrestricted competition is the permanent rule of business among civilized men. There is a good deal of sound sense in this book, and a good deal which a closer study of men and affairs, instead of abstract theories, would lead the author to revise.

TRADE PUBLICATIONS.

THE NORDBERG CORLISS ENGINE. Built by the Nordberg Manufacturing Co., Engineers and Machinists, Milwaukee, Wis. 8vo; pamph.; pp. 33.

The description given of this engine, which has a number of special features claimed to be decided improvements, is admirably clear and full. It is evident that the details have been carefully studied, not only in relation to the several parts of the valve gear, in which most variations of practice occur, but in relation to the frame, crank, bearings, connecting rods and other like parts, the design of all of which is fully shown, and which certainly seem to have some good points. This company is a comparatively young one, and we may mention that it has recently secured a contract for a pumping engine at Winchester, Va., as stated in our Contract Prices column April 19, and that it recently submitted the lowest bids for a 5,000,000-gallon pumping plant at Washington, D. C.

PUMPS, FLEXIBLE PIPE JOINTS AND ADJUSTABLE GATE BOXES: M. Walker, Fenton, Mich. Unpaged; illustrations.

This is a handsome catalogue describing and illustrating the Walker pumps, largely used in connection with water-works in Michigan, the Walker flexible joint for submerged pipelaying, and an adjustable gate box, the cap to which has a kind of flexible joint designed to allow it to fit the street surface and to give sufficient play to prevent any of the parts being broken when a heavily loaded wagon passes over it.

STANDARD APPARATUS FOR INTERLOCKING AND BLOCK SIGNALS. National Switch & Signal Co., Easton, Pa. 4to; pp. 48; illustrated.

This is a preliminary pamphlet issued in advance of the complete catalogue, now in preparation, and illustrates and describes briefly the principal signaling appliances manufactured by this company, and already familiar to many of our readers. The typography is clear and neat and the half-tone illustrations, among which is one of the company's new plant at Easton, Pa., are appropriate and well executed.

SOCIETY PROCEEDINGS.

CIVIL ENGINEERS' SOCIETY OF ST. PAUL.—At the meeting on May 7 a paper was read by Mr. O. Claussen on "The Requirements of a Municipal Electric Light Plant Installation." He advocated the location of the power house near a plentiful supply of water that compound condensing engines might be used, yet far enough from the business center to escape excessive cost of real estate and near enough to profit by transportation facilities and to minimize length of pole lines. Tiled floors for engine and dynamo rooms were suggested, rubber mats to be placed where necessary for protective insulation. A traveling crane as a fixture would assist in handling equipment. Machinery foundations to be massive and built of hard burned brick laid in Portland cement. He favored low speed, triple expansion engines, water-tube boilers, extra feed pump capacity, economizers and smoke consumers. Steam pipes to be furnished with magnesia casing and fitted with numerous valves in case of accidents. For arc lighting the general practice seems to demand shafting and belt connections, while direct connection between engine and dynamo is common for incandescent lighting. The direct constant current arc light machine is now constructed to operate in safe practice 100 2,000-c. p. lamps with a voltage of 5,000 and a current of 10 amperes. In this vicinity with a first-class plant a system of 1,000 lamps should be operated all night and every night at a total cost of $90 per lamp per annum.

C. L. Annan, Secy.

ENGINEERS' CLUB OF PHILADELPHIA.—At the meeting on May 5 Mr. Joseph T. Richards was unable to be present, and his paper on "Rebuilding the Pennsylvania R. R. After the June Flood, 1889," was postponed, but at the call of the chair there was the following discussion:

Mr. John Birkinbine.—I would call attention to the immense volume of water by which the Pennsylvania R. R. at Johnstown was destroyed at that time.

We see the volume of water flowing past Philadelphia in its two rivers, but do not consider that during the year probably four times as much rain has fallen on their water-sheds as is represented by that flow. And the same may be said of the rivers of the earth.

Professor Loomis claims that the average height of clouds is two miles. Although this is probably correct, I think there is no doubt on the other hand that many clouds from which we see rain falling are within half a mile of the surface of the earth. To make a moderate calculation, let us assume as a minimum distance 3,000 ft. A rainfall of 1 in. in an hour would amount to 72,600 tons of water deposited on each square mile, to elevate which 3,000 ft. would mean an amount of work equal to 220,000 HP. To raise this water in an hour by pumping engines giving a duty of 100,000,000 ft.-lbs. would require the consumption of 200 gross tons of coal. I think this will help us to appreciate the immense amount of work being done by the sun in storing up our natural water supply. If the average elevation of Philadelphia is 84 ft., then we have 4,517 HP. developed for each square mile for a rainfall run-off in an hour. When these quantities are considered, the wonder is that when we have such down-pours as that which caused the Johnstown flood, the damage is not much greater than it was on that occasion.

Mr. Amasa Ely.—While Mr. Birkinbine's rainfall value of 1 in. per hour is a high one, it is not a very unusual nor a maximum one. I remember that some years ago (about August, 1886, I think), there was a fall of 1½ ins. in Philadelphia in 20 minutes.

In 1885 an experiment was made by preparing two sets of slopes with diamond-shaped areas of sodded, plowed, and wooded ground, from which the rainfall that ran off was collected and measured. The amount of run-off varied, if I remember rightly, from 15 to 60% of the rainfall. An average territory in this vicinity would show, I think, about a 50% run-off. In Great Britain I think the average is 40%.

The Secretary then read a paper on "The Electro-Metallurgy of Gold and Silver," by Mr. A. L. Eltonhead. After calling attention to the difficulties to be contended with in using the cyanide process in extracting the gold from the ore, the author explained a small plant that had been erected on the West Side mine of the Tombstone Mill & Mining Co. for working what is known as the electro-chemical process. This overcomes the difficulties encountered in precipitation in the cyanide process, and the resultant precipitate is recovered in the shape of amalgam. After being crushed to proper fineness the ore is placed in leaching vats with false bottoms for filtration, and a solution of cyanide of potassium is run over the pulp and left to stand a certain number of hours. This is then drawn off and a second solution of less strength is then used in the same way, the pulp being afterwards washed in clean water and drained. All the solutions from the leaching vats are saved and passed over a precipitating "box" of novel construction.

This process possesses many advantages over other cyanide methods, among which may be mentioned its cleanliness, quickness of action and cheapness. It has the advantage over the chlorination process of being capable of dissolving and then precipitating the gold and silver in one operation, and it is cheaper in cost of plant and treatment. With a plant having a capacity of handling 10,000 tons of pulp per month, the cost of treatment should not exceed $2 per ton, and this may be cheapened by labor-saving devices.

COMING TECHNICAL MEETINGS.

ENGINEERS' CLUB OF PHILADELPHIA.
May 19. Secy., L. F. Rondinella, 1122 Girard St.

SWEDISH ENGINEERS' CLUB.
May 19. Secy., P. Valentine. At 231 Union St., Brooklyn, and 646 North 10th St., Philadelphia. At 106 Randolph St., Chicago. Secy., C. T. Anderson.

DENVER SOCIETY OF CIVIL ENGINEERS.
May 20. Secy., F. E. King, Jacobson Block.

ENGINEERS' CLUB OF MINNEAPOLIS.
May 21. Secy., E. Nexsen, 504 Kasota Block.

ASSOCIATION OF CIVIL ENGINEERS OF DALLAS.
June 1. Secy., E. K. Smoot, 803 Commerce St.

TECHNICAL SOCIETY OF THE PACIFIC COAST.
June 1. Secy., O. Von Geldern, 719 Market St., San Francisco.

AMERICAN SOCIETY OF MECHANICAL ENGINEERS.
June 5, 8. Convention at Montreal, Can. Secy., F. R. Hutton, 12 W. 31st St., New York City.

WESTERN SOCIETY OF ENGINEERS.
June 6. Secy., Thos. Appleton, Lakeside Bldg., Chicago.

AMERICAN SOCIETY OF CIVIL ENGINEERS.
June 6. Annual meeting at Niagara Falls, June 20. Secy., F. Collingwood, 127 E. 23d St., New York.

ENGINEERS' CLUB OF ST. LOUIS.
June 6. Secy., Wm. H Bryan, Turner Bldg.

MONTANA SOCIETY OF CIVIL ENGINEERS.
June 9. Secy., G. O. Foss, Helena.

ENGINEERS' CLUB OF KANSAS CITY.
June 11. Secy., Waterman Stone, Baird Building.

WISCONSIN POLYTECHNIC SOCIETY.
June 11. Secy., M. F. Schinke, City Hall, Milwaukee.

CIVIL ENGINEERS' CLUB OF CLEVELAND.
June 12. Secy., F. C. Osborn, Case Library Building.

NORTHWEST RAILWAY CLUB.
June 12. Secy., W. D. Crosman, Ryan Hotel, St. Paul.

NORTHWESTERN SOCIETY OF ENGINEERS.
June 12. Secy., D. W. McMorris, Burke Blk., Seattle, Wash.

MASTER CAR BUILDERS' ASSOCIATION.
June 12, 16. Saratoga, N. Y. Secy., J. W. Cloud, Rookery Building, Chicago.

CIVIL ENGINEERS' ASSOCIATION OF KANSAS.
June 13. Wichita, Kan.

NEW ENGLAND RAILROAD CLUB.
June 13. Secy., F. M. Curtis, P. O. Box 1576, Boston.

ENGINEERING ASSOCIATION OF THE SOUTH.
June 14. Secy., Hunter McDonald, Nashville, Tenn.

ENGINEERS AND ARCHITECTS' CLUB OF LOUISVILLE.
June 14. Secy., G. W. Shaw, Norton Building.

NEW ENGLAND WATER-WORKS ASSOCIATION.
June 14, 16. Annual convention at Boston. Secy., R. C. P. Coggeshall, New Bedford, Mass.

NORTHWESTERN TRACK AND BRIDGE ASSOCIATION.
June 15. Secy., D. W. Meeker, St. Paul.

TACOMA SOCIETY OF ENGINEERS AND ARCHITECTS.
June 15. 201 Washington Building.

CANADIAN SOCIETY OF CIVIL ENGINEERS.
June 17. Secy., C. H. McLeod, Montreal, P. Q.

MASTER MECHANICS' ASSOCIATION.
June 19, 23. Saratoga, N. Y. Secy., Angus Sinclair, Temple Court, New York.

COLUMBIAN ENGINEERING SOCIETY.
June 19. Secy., F. W. Hart, Washington, D. C.

BOSTON SOCIETY OF CIVIL ENGINEERS.
June 20. Secy., S. E. Tinkham, 36 Bromfield St.

NEW YORK RAILROAD CLUB.
June 21. Secy., John A. Hill, Temple Court.

ENGINEERS' CLUB OF CINCINNATI.
June 21. J. F. Wilson, 24 W. 4th St.

SCANDINAVIAN ENGINEERING SOCIETY OF CHICAGO.
June 21. Secy., Howard Berge, 100 Washington St.

ENGINEERS' SOCIETY OF WESTERN PENNSYLVANIA.
June 21. Secy., Daniel Carhart, Carnegie Lib. Bldg., Allegheny.

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AND

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The date when the subscription expires is on the address label on each paper: the change of this to a subsequent date is the only receipt sent, unless by special request.

ADVERTISING RATES: 20 cents per line agate measure. Want notices, special rates, see page 22. Rates for standing advertisements sent on request. Changes of advertisements must be in hand on Monday afternoon; new advertisements, Tuesday afternoon; transient advertisements by Wednesday noon.

The subject of railway economics was very ably presented by Col. H. S. Haines at the recent meeting of the American Railway Association, and his description of the actual effects of reducing rates should be studied closely by every executive officer. He showed very clearly, what, indeed, is well known and generally acknowledged, that the reduction of rates in the management of competitive traffic has been carried to excess and must lead, as it has already led, to disastrous consequences. The proportionate increase in the volume of traffic grows less every year, while the competition for the traffic is increasing. If the volume of traffic does not increase more rapidly than the rates decrease, the total revenue from competitive traffic must decrease and the deficiency must be made good by reductions in operating expenses, which is the state of affairs now generally prevailing. The reason for this is largely that the traffic officials do not understand the effects which their operations have upon the financial conditions of the roads, and do not recognize that it is better to relinquish traffic than to take it at a rate which is less than the cost of service. Then, too, they are allowed to carry on operations unchecked. Yet it is to them that the companies must look for relief from the present discouraging conditions. In regard to the question of ascertaining the lowest rate at which it pays to take traffic, Colonel Haines pointed out that the average rate per ton-mile has no significance in practice, and suggested that the cost of service should be reckoned by car-miles instead of ton-miles, and this with the cost of terminal service added, would give the means of practically arriving at the actual rate below which the traffic is merely at a loss. Reduction in operating expenses (which is very different from economy in operation) is in many cases being carried to too great an extent to balance the reckless and unreasonable reduction in rates, and the absurd way in which the cutting of rates has been carried on without regard to operating expenses is probably a large factor in causing so many railways to go into the hands of receivers.

The discussion on coil boilers at the Mechanical Engineers' meeting on May 9 was rendered notable by the presence and participation of the venerable B. F. Isherwood, late Engineer-in-Chief U. S. N., who occupies somewhat the same position with respect to the development of steam engineering in this country that the late Jas. B. Francis occupied with reference to hydraulic engineering. Mr. Isherwood's remarks in the discussion, which are given in full in another column, held the attention of his audience by virtue of his striking personality and authoritative statements, as well as by the importance of the facts which he presented.

The chief idea put forth by Mr. Isherwood, that the internally fired boiler has a permanent superiority to the externally fired boiler by reason of its freedom from air leakage and smaller loss by radiation, is not novel, but it is not so generally understood by engineers as it should be. On the other hand, the statement should not be given too broad an application. What Mr. Isherwood says is that given two boilers with an equal extent of heating surface and grate surface, but one set in brick and externally fired and the other internally fired, the latter boiler will use 10% less fuel in making a given amount of steam. Now, this must be understood as applying to marine practice, where there is never room for surplus heating surface, and where the gases are sent to the chimney at a temperature of 600° to 800°. But in stationary practice with return tubular boilers, where 400° to 550° represents about the range of temperatures of the chimney gases, the loss through the surplus air which leaks in is much less. Again, in the best of stationary practice of the present day, where the flue gases are sent through economizers after leaving the boilers, the temperature of the gases is reduced still more, and they may pass up the stack at a temperature of only 200° to 300°. In this case the loss of heat by surplus air leaking into the furnace and combustion chamber is only that required to raise the air through 100° to 250° of temperature. It is also to be remembered that the brick furnace of an externally fired boiler plays the same part as a brick arch in an internally fired boiler in promoting and equalizing combustion, and preventing smoke and the loss of unconsumed gases up the chimney. It is claimed, further, by some experimenters that an internally fired boiler, even when provided with a brick arch, is always subject to a certain loss by the limited room available for combustion, and the cooling effect of the water-surrounded metal plates, upon the fire, especially when the latter is burning at a moderate rate.

We gave figures last week of the comparative cost of ordinary construction and fireproof construction for a $125,000 building in Philadelphia, showing a difference in cost between the two systems of only 3.6 per cent. As evidence that the marked reduction in the cost of fireproof construction applies to buildings of moderate size and cost as well, we reprint the following letter from the correspondence column of our contemporary, "Architecture and Building:"

Dear Sirs: In making some drawings recently for city houses I had estimates made for construction in the usual way and also for fireproof construction. The estimates for the ordinary construction were $19,980 and for fireproof construction were $20,615. This was for three four-story American basement houses on lot 50 × 100 ft., and included everything but wood finish and plumbing, which would cost the same in both cases. This difference of $635 on three houses shows that one kind of construction was practically as inexpensive as the other if the estimates, which were made by reliable parties, were correct. The fireproof construction saved 17 ins. width of floor space in each house. A full set of drawings were made in each case. Yours very truly,

Manly N. Cutter.

New York, April 25, 1894.

Additional force is lent to the above figures and those which we gave last week by the destruction on May 15, of the largest Protestant church edifice in America, and one of the largest and finest hotels, causing a total loss of over a million dollars. Again in the suburbs of Boston on May 15, a fire swept over 12 acres of ground, burning mostly small frame dwellings, but causing in the aggregate a heavy loss. One notable feature with respect to the burning of the Brooklyn Tabernacle was the fact that the fire was spread over the great auditorium with startling rapidity by the papier mache covering of the walls and ceiling. All accounts agree that had the fire broken out a few minutes earlier, while the congregation of 6,000 persons still crowded the church, a great holocaust must undoubtedly have occurred. It seems well nigh incomprehensible that a building designed to hold a great public assembly could have been deliberately made such a tinder box by those entrusted with its design and construction. The pitiful excuse that the papier mache was cheaper than plaster is the only reason that has thus far been made public for the use of this material. The walls of the church seem to have been reasonably solid and substantial, and had it not been for this inflammable interior wall covering, it is quite probable that the fire might have been got under control.

It cannot be too often repeated that a serious fire may occur in even the best fireproof structure provided sufficient inflammable material is furnished for the flames; and although the structure itself, if properly built, will not be destroyed, the contents will be a total loss. Interior wood finish, saturated with oil and covered with varnish, furnishes an excellent material for the spread of fire, as has been proved time and again. Yet little attention is paid to the fact even where one would most expect to find it appreciated. As an example of this there lies on our desk the catalogue of Purdue University, which lost its fine engineering building by fire four months ago, only three days after its completion and dedication. Turning to the catalogue we find that the electrical building, another structure on the college grounds, "is a handsome, three-story structure, of dressed stone and brick, finished inside in oil-varnished red oak." Among the contents of this building are a laboratory, an engine and dynamo room, and a work shop with machine tools, etc. That a structure involving such special risks of fire should be made proof against the spread of flames so far as possible would seem a proposition evident enough. If wood finish must be used, there are fireproof paints on the market which would render it practically incombustible, and it were surely wise in such a structure to sacrifice something of the ornamental for the sake of safety against fire.

THE RISE OF THE RAILROAD CLUB.

In the steadily lengthening list of "Coming Technical Meetings," which each week concludes our columns devoted to "Society Proceedings," are the names of a half-dozen railway clubs. The rise of these organizations to prominence and importance among American technical societies is so interesting a circumstance, and has occurred under such peculiar conditions, that some comment upon it in these columns is appropriate. In the first place, the rise of the local railway clubs, and even of the national railway associations, to a prominent place among technical societies is something quite new. Broadly speaking, we may say that the railway associations have experienced their rapid rise in importance among technical associations since civil and mechanical engineering methods have begun to considerably displace old-fashioned rule-of-thumb methods in railway work. More definitely, the railway clubs and railway associations generally are still in a transition stage. Some of them compare favorably in the character of their papers and discussions with the national engineering societies. Others retain much of the triviality and crudeness which were common to all a dozen years ago. We believe the Western Railway club is entitled to the credit of being the first of the local railway clubs to raise the character of its work to a level with that of the best of the local engineering societies, and it is still entitled to first place among the clubs for the value of its papers and discussions. Next to it, in point of technical work, should be placed the New York club, with the Central club, located at Buffalo, a close third. This latter club has never had read before it such important and valuable papers as have been read before the Western and New York clubs; but its discussions are excellent and contain matter of no small technical importance.

The three remaining railway clubs rank considerably below the three first named in the character of the work, and should be graded in the order of their importance as follows: Southern & Southwestern club, New England club, and Northwest club. The first named has its headquarters at At-

lanta. The New England club, which, by the way, is one of the oldest, is of course at Boston, and the Northwest club is located at St. Paul.

A peculiar feature respecting all these clubs is the part which the supply-men have taken in their evolution, a part so important that it is probably safe to say that in large part the clubs owe their existence, and they certainly owe their unexampled financial prosperity, to the generosity, or more accurately, perhaps, to the business sagacity, of the supply-men. The opportunity to extend their acquaintance among railway officers which the railway club offers to the agents of supply houses is correctly described as a golden one, and the agents have not hesitated to recognize it. In all the clubs the membership fee is merely nominal, and any deficit in current expenses has been made up by the supply men's subscriptions. Up to a year or two ago, no regular proceedings were published by any of the clubs with the exception of the Western; but now all the clubs except the one at St. Paul publish their papers and verbatim reports of their discussions in monthly pamphlets, which have, we are gratified to record, been made uniform in size with the proceedings of the national engineering societies. Since the publication of "proceedings" began, the supply-men's subscriptions for club expenses have taken the form of payment for advertising space in these monthly pamphlets. This suits both the supply houses and the club members, for it gives the former a certain additional return for their expenditure and the club is not placed in the light of relying on gifts from outsiders to pay its running expenses.

We may note here, as a matter of interest in connection with the clubs' financial affairs, that one luxury in which all, or nearly all, of the clubs indulge is a paid secretary, and the salaries allowed are extremely liberal considering the very small amount of work involved.

In the early days of some of the clubs, and in some of them even at the present time, the supply-men took prominent part in the discussions, and sometimes read papers describing and advocating their own particular specialties. Some very exciting meetings were the result of this in some instances, as, for example, when all the agents of car-heating appliances once spent an evening in the New York club in telling each other and a very few railway officers what were the relative merits of their respective devices. While meetings of this sort left nothing to be desired with respect to briskness of discussion, they proved a failure as a means of attracting railway officers to the club, for the very good reason that they had heard it all before. The supply-men were the first to recognize this, and either by by-law or by tacit consent nearly all the railway clubs now conform to the example set by the Master Car Builders' Association and permit no discussion by patentees or manufacturers or their agents with respect to the merits of their goods. We are disposed to believe that this rule might be relaxed somewhat with benefit to all concerned, and that it does at times shut out valuable information from being recorded in the clubs' proceedings, but it does also, unquestionably, shut out much objectionable matter from intrusion there.

A word more on this subject of the description or discussion of the merits of manufactured or patented articles may not be out of place here, as it is a matter continually recurring in all technical societies. On the other side of the water such old and conservative societies as the Institution of Civil Engineers and the Iron and Steel Institute admit freely to their transactions papers and discussions describing patented processes, etc. In fact, the key to the value of the Institution's proceedings arises from the practice of its efficient secretary of securing the attendance and participation of every one possible who has had special experience in the line of work under discussion; and as a matter of course such persons almost invariably have financial interests at stake in the matter on which they speak. But this can be done in these societies, as it could not in an American technical society without the introduction of objectionable matter, because the discussions are edited by the secretary before publication. The discussions published in the "Transactions" of the Institution of Civil Engineers and of the Iron and Steel Institute are not the remarks of the members verbatim, but are the substance of their remarks stated in concise language by the secretary and with trivial or objectionable matter eliminated. This method of reporting discussions in technical societies has never found favor in this country, but its adoption would do much to reduce the quantity and improve the quality of all society proceedings. A large part of the desultory and trivial talk which goes on in almost every technical discussion could be eliminated before putting into print with real gain, in that the meat of the matter under discussion would not be buried beneath so much rubbish.

But the question of most interest with respect to the railway clubs is the causes which have brought about the rapid rise of some of them to prominence and importance. The reason, apparently, is not hard to find. The phenomenal excellence of the papers and discussions of the Western club, we take it, is due first and foremost to the fact that it is the place where the results obtained in the mechanical laboratories of the principal railways centering at Chicago are made public. The New York and Central and Southwestern clubs have not among their working members those who are investigating current railway problems with the special facilities possessed by the Chicago, Burlington & Quincy, or the Chicago, Milwaukee & St. Paul. Thus the superiority of the Western club is due not to lack of zeal or of the spirit of investigation on the part of the leading members of the other clubs; but with the exception of the Pennsylvania R. R., no Eastern railway has given its mechanical officers free rein in the investigation of new problems of importance as the leading Western roads have done.

Another reason for the success of the railway clubs lies in the fact that the members who take part in the discussions are practically experienced in the subjects on which they speak. A defect in the discussions in many of the local engineering societies is that of the half-dozen members who take part, each one is engaged in a different line of work, and his off-hand opinions on the subject under discussion are very likely to be of no value whatever. But in a railway club all the members are in substantially the same line of work, and the chances are that when a subject is brought forward, some one has found some new fact with respect to it which is really worth putting on record.

If we were asked for a definition of the most valuable technical literature we should say it was the record of careful study and solution, by proper methods, of an unsolved problem, of sufficient practical importance to justify the work. There is no lack of theories and schemes and opinions in the grist which comes to the editorial mill; but there is always room for the record of facts bearing on new and important problems, when such facts have been dug out of the mine of experience.

We have alluded to the influence of the spread of engineering methods in the evolution of the clubs. To this perhaps, more than any other one cause, is due the steady and rapid increase in value of their proceedings. When a problem is investigated, not by the cut-and-try plan, but by the methods of the scientist and engineer, its solution may throw light on a dozen other obscure problems in totally different fields. Take, for example, the causes of failure of firebox steel. Investigated and studied in a broad and thorough manner, the results of the work would contain matter of value to engineers in a dozen wholly different lines of work. On the other hand, if studied according to the methods of the old-fashioned master mechanics who flourished a score of years ago, the result, if it had any value at all, would have value as regards that single use of steel plates only.

Bearing in mind the influences which have brought about the rise of the railroad clubs, it is not hard to see that their importance and influence are destined to steadily increase. The spread of engineering methods in railway work is rapid, and more and more the responsible change of track and rolling stock is coming into the hands of men trained in the technical schools. The railway interest is as great a factor in this country's engineering as the shipbuilding interest is in English engineering, and the societies in which those are associated who are charged with the maintenance and development of American railways are certainly destined to take no backward steps.

LETTERS TO THE EDITOR.

HOW NOT TO MAKE CONCRETE FOR BRICK PAVING FOUNDATIONS.

Sir: During a recent investigation of the manner in which some brick paving was laid last summer in this city, it transpired that here, beneath the very shadow of one of the greatest engineering and technical schools of this country, the paving commission, composed of hard-headed business men, saw fit to employ no engineer, either to draw the specifications or to take charge of the work. They compiled their specifications from those of other cities, and to show how well the compiler did his work I quote the paragraph relating to the concrete upon which the brick were laid, as follows:

One measure cement, two of sharp sand, will be thoroughly mixed dry and made into a mortar with as little water as possible. (Here follow several sentences dealing with the character of the cement and broken stone.) The stone and mortar will be incorporated immediately in the proportion of one part mortar and five parts stone, and shall be regulated by measure.

The concrete, when taken up for inspection by the engineers present, was water-soaked, and would not hold together, but crumbled into its constituent parts under the most careful handling. The reason for its appearance and behavior was only discovered when the endeavor was made to reproduce some of this concrete, under these specifications, in the laboratory of the College of Civil Engineering at Cornell.

It was here found that under the perfect conditions available in the laboratory, it was not possible to make a concrete with such proportions, viz., 1 part cement with 17 parts of sand and stone.

Very respectfully yours, Engineer.

Ithaca, N. Y., April 30, 1894.

PROPOSED STATE WATER SUPPLIES IN NEW JERSEY.

Sir: Referring to the editorial in the Engineering News of May 10 on the New Jersey water question, I enclose you a copy of a paper I wrote on the subject six years ago, which, I trust, will interest you.

The present and past status of the matter is properly stated in your editorial in these words:

As the officials of these companies are intimately connected with politicians of both parties, it would not be surprising if the bill were killed.

When I studied the question six years ago it appeared as if every prominent lawyer from the Attorney-General down was retained by the Bartlett syndicate, and every prominent politician had some interest in it. It is a question between the vested interests of syndicates, lawyers, politicians and capitalists, thoroughly organized, and the mass of the public, uninformed and unorganized. Some day the people will wake up to the necessity of the state's controlling the water supply, and then it will require many millions of dollars for the state to acquire the rights which it might have purchased for a trifle ten years ago. Yours truly,

Passaic, N. J., May 12, 1894. Wm. Kent.

(The paper by Mr. Kent reviewed in a comprehensive way the water supply question in Eastern New Jersey, as it stood in 1888, and urged that the state secure title in the important water rights needed for the supply of its urban population. The paper quotes from the report of the New Jersey State Geologist for 1876, in which a scheme for a comprehensive water supply was outlined, and also from the message of Gov. Greene, in 1888, to the New Jersey Legislature, in which attention was called to the importance of the question under discussion. For a number of years past many of the messages sent from the governor to the legislature speak more or less favorably regarding this matter, and year after year it is urged upon the attention of the people or the legislature through the report of the state geologist and in other ways.—Ed.)

SANDBERG SECTIONS FOR 100-LB. RAILS.

Sir: I have read with pleasure your article on my 100-lb. new and old rail section in your issue of April 19. I have made up a similar comparative table between my new and old and your American sections, which I send herewith.

I look upon excessive hardness of rail steel, now brought in as a cure for crushed rail ends, as a great source of danger for fracture and accidents, and think the increased bearing which my new standard sections afford, along with adoption of heavier sections, is a better and a safer plan. In this view I am supported by the President of the Iron and Steel Institute. As a proof that these sections can be rolled well, I send a piece cut from my 50-lb. rail. Yours truly,

C. P. Sandberg.

London, England, May 2, 1894.

(The table referred to by Mr. Sandberg, com-

paring the dimensions of his new and old sections with those of the sections recommended by the committee of the American Society of Civil Engineers, is given below. The Sandberg sections are too well known to need description here, but we cer-

Comparison of Sandberg and Am. Soc. C. E. Recommended Rail Sections.

Weight per yd., lbs.	Height			Width of head.			Depth of head.			Thickness of edge of flange.			Width of flange.			Thickness of web.		
	S., old, ins.	Am. Soc. C.E., ins.	S., new, ins.	S., old, ins	Am. Soc. C.E., ins.	S., new, ins,	S., old, ins.	Am. Soc. C.E., ins.	S., new, ins.	S., old. ins.	Am. Soc. C.E., ins.	S., new, ins.	S., old, ins.	Am. Soc. C.E., ins.	S., new, ins.	S., old, ins.	Am. Soc. C.E., ins.	S., new, ins.
100	5¾	5¾	5¾	2⅝	2¾	3	1⅞	1 45-64		1⅞	⅝ 5-16	⅝	5½	5¾	6¼	11-16	9-16	17-32
80	5	5	5¼	2⅝	2½	2¾	1 21-32	1½		1 11-16	⅝ 9-32	5-16	4⅝	5	5¼	½	35-64	15-32
70	5	4⅝	5	2¼	2 7-16	2½	1 21-32	1 11-32		1 17-32	¼ 9-32	9-32	4½	4⅝	5	15-32	33-64	7-16
60	4½	4¼	4½	2¼	2⅜	2½	1½	1 7-32		1⅜	¼ ¼	¼	4	4¼	4⅝	7-16	31-64	13-32
55	4¼	4 1-16	4½	2¼	2¼	2⅝	1 19-64	1 11-64		1 5-16	¼ ¼	¼	4 1-64	4 1-16	4⅝	7-16	15-32	13-32
50	4⅛	3⅞	4½	2⅛	2⅛	2¼	1 5-16	1⅛		1 9-32	¼ 7-32	¼	3 9-16	3⅞	4⅛	7-16	7-16	⅜
45	3¾	3 11-16	3¾	2	2	2⅛	1 3-16	1 1-16		1¼	¼ 7-32	¼	3½	3 11-16	3⅞	13-32	27-64	⅜
40	3½		3⅜	..	1⅞	2	..	1 1-64		1 3-16	.. 7-32	¼	..	3½	3⅝	..	25-64	5-16
35	..	..	3⅜	..	..	1⅞	..	..		1⅛	.. 7-32	..	..	..	3⅜	..	..	5-16
30	..	..	3⅛	..	..	1¾	..	..		1	.. ..	7-32	..	..	3⅛	..	..	9-32

tainly believe in a longer radius for the head, a shorter radius for the top corners and a flatter fishing angle.—Ed.)

THE METROPOLITAN SEWERAGE SYSTEMS OF MASSACHUSETTS.

(Continued from p. 386.—With inset.)

The 5-ft. siphon beneath the Mystic River connecting with the pumping station at Charlestown, Contract Section 25, is shown by Fig. 1, on the inset, and has been described by Mr. H. A. Carson, Chief Engineer,* as follows:

A sewer tunnel is now (December, 1893) being built under Mystic River, parallel with and about 58 ft. from Malden bridge, and when completed it will extend from Tuft's Mill Pond to the site of the Charlestown pumping station, a distance of about 862 ft. It has now nearly reached the pumping station. The bore of the tunnel before the brickwork is put in is about 7 ft. in diameter. The average depth of the bottom of the tunnel excavation below the floor of Malden bridge is about 45 ft. The average thickness of the earth over the crown of the arch is about 15 ft. At some places it is only about 6 ft. A shaft 49 ft. deep is located at a point about 50 ft. from Mystic River, at the southerly end of Malden bridge. Large quantities of sulphuretted hydrogen were encountered in excavating this shaft, so that the men were able to remain in it but for about an hour at a time. The annoyance from the sulphuretted hydrogen was partially alleviated by forcing a volume of fresh air into the shaft by means of air compressors. About 1 a. m., June 6, a pocket of carbonic acid gas was struck. The gas flowed into the trench and suffocated two men almost instantly and overcame a foreman who went to their assistance. The foreman was rescued, and recovered in a day or two. After a trial of various measures which proved only partially remedial, a vertical lock was put in the shaft and the sinking finished by the use of compressed air. The shaft was down June 30 and the heading commenced. A horizontal air-lock was put in the tunnel, and excavation under pressure began July 24. The roof of the tunnel is kept in place as digging progresses by steel-flanged plates bolted together and supported temporarily by screw braces. These plates usually extend about one-third of the way around the periphery of the tunnel bore. Sometimes in treacherous earth they are made to extend much further. The tunnel invert is usually 1 ft. in thickness. The arch varies from 1 to 2 ft. in thickness, and averages about 15 ins. The material excavated in tunneling has been mainly in clay, but partly of sand.

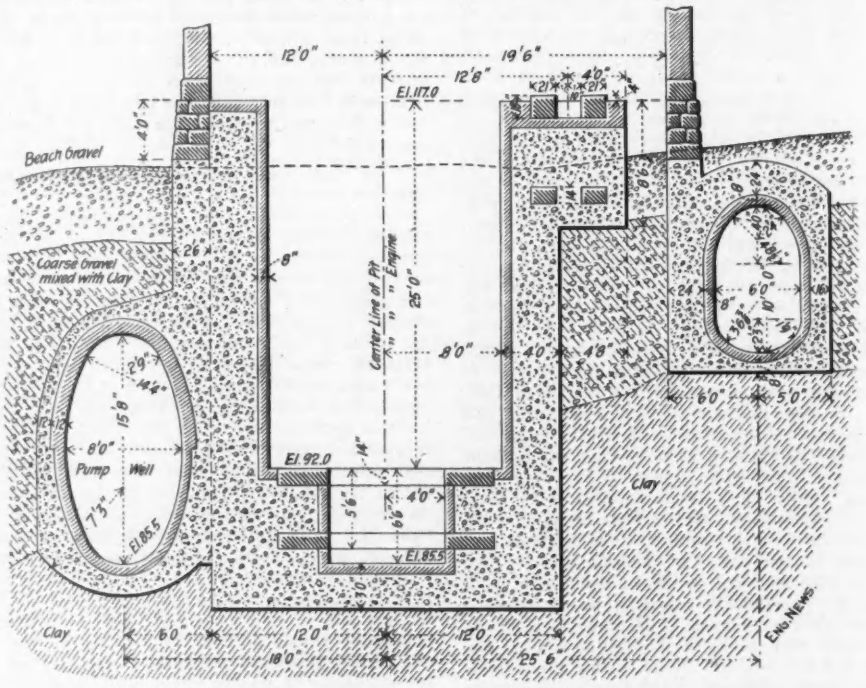
During the progress of this work bubbles of air have been seen to freely escape from the water above the tunnel. On the last day of October the agitation near the end of the tunnel as then excavated was more violent than usual, and two compressors were required to keep up the pressure. The men stopped work at midnight and went outside to eat. On their return the leak was found to be greater than before. They made some efforts to stop it, but as the leak was increasing at a dangerous rate they were forced to retreat a distance of more than 600 ft. to the interior of the air-lock and close its door. The water was then knee deep in the tunnel and lock, and rising fast. Fortunately no lives were lost. The next day soundings revealed a crater-shaped hole near the end of the tunnel. Repairs were begun by filling the hole with clay. A canvas sail was obtained and weighted on one side. It was sunk in such a manner that the current caused the canvas to spread over the clay-filled hole. The canvas was then covered with clay. The tunnel was soon afterwards pumped out, and progress has since been uninterrupted.

The plant used in connection with this tunnel, as given in Mr. Carson's last annual report, was as follows: A vertical and a horizontal air-lock; a 16×24-in. and an 18×20-in. Ingersoll air compressor, with capacities at 90 revs. of 350 and 375 cu. ft. per minute; an air receiver; three 45×108-in. vertical boilers; a Harrisburg "Ideal" engine; a 6×8-in. Lidgerwood hoist engine; a No. 5 pulsometer pump; and a 66-light Westinghouse incandescent dynamo.

The air pressure used from June 23 to Sept. 30, 1893, ranged from 13 lbs. per sq. in. at low, to 18 lbs. at high tide. The maximum air pumpage per 24 hours was 680,000 cu. ft., the minimum 160,000, and the average 300,000. To Sept. 30 the average weekly progress of tunnel excavated and bricked was 32.7 ft. Flanged and bolted steel plates were used to support the roof of the tunnel.

The general arrangement of the Charlestown pumping station is shown by the plan and section at the left of Fig. 1 and the pumping station at East Boston is shown in a similar manner in Fig. 2, on the inset.

The accompanying illustration in the text shows a cross-section of the foundations of the pumping station at Deer Island, near the outlet to the ocean. The pump well will be in the nature of a continuation of the sewer proper, as shown at the left. The centrifugal pumps will be located in the pits and will discharge into the conduit at the right of the station.



CROSS-SECTION OF FOUNDATIONS FOR DEER ISLAND PUMPING STATION.

The tunnel beneath Chelsea Creek, on Section 10, shown in Fig. 2, was finished on May 4, 1893. The following information regarding the features of the system shown on the inset sheet is abstracted from Mr. Carson's report for the year ending Sept. 30, 1893:

In sinking Shaft No. 1 much difficulty was encountered owing to its proximity to the creek, a railway crowding the work at this point. The shaft was carried down 15 ft., with a section 22×24 ft., into what appeared to be impervious material. It was then continued with a section 13×14 ft., tongued and grooved sheeting being extended to the surface and the surrounding space filled with fine sand. At 18 ft. the ground was so porous and water came in so freely that it was necessary to work by tides. A neat cement grout was poured in behind the sheeting and in places where stones prevented excavation to the true line of the sheeting the spaces were filled with rich concrete. From Sept. 26 to Nov. 9, 1892, was required to sink the shaft. A 4-in. centrifugal pump was used until the lift became too great, after which a 5-in. pulsometer pump was used.

A north heading was started Nov. 10 and a south heading Nov. 15, followed by masonry four and two days later, respectively. On Nov. 27 a pocket of sand was struck in the roof of the north heading, 35 ft. from the shaft, and sand and water flowed in, making necessary the building of a bulkhead and the stoppage of work on this heading until an air-lock could be put in. At midnight, Dec. 4 and 5, the water from the creek broke into the shaft, from 33 to 42 ft. from the top, and flooded the work. Dec. 10 the water was pumped down by the Blake pump and Dec. 30 the shaft had been repaired and cleaned out. Apparently the timbering was too light for the water pressure. An oval concrete lining, 7⅔×8⅔ ft., was built in the shaft. On Jan. 15 work was resumed in the south heading and on Jan. 26 excavation under air pressure was begun in the north heading. From Jan. 20 to Feb. 28 a second shaft was put down at the other end of the tunnel.

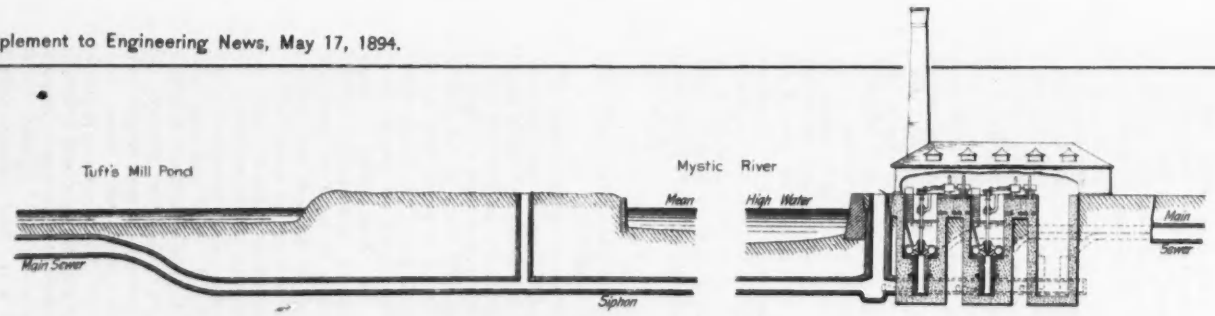
For a part of the tunnel work steel plates 1 ft. wide were used to support the roof, being placed every alternate foot or ring. In hardpan the plates were 9 and 12 ft. long, alternately, measured on the circumference, and in fine sand and silt all plates were 12 ft. in length. Through a part of the length of the tunnel a timber cradle was necessary. The best progress was through sand or silt, the next best through clay and the poorest through hardpan.

Regarding the bracing Mr. Carson states:

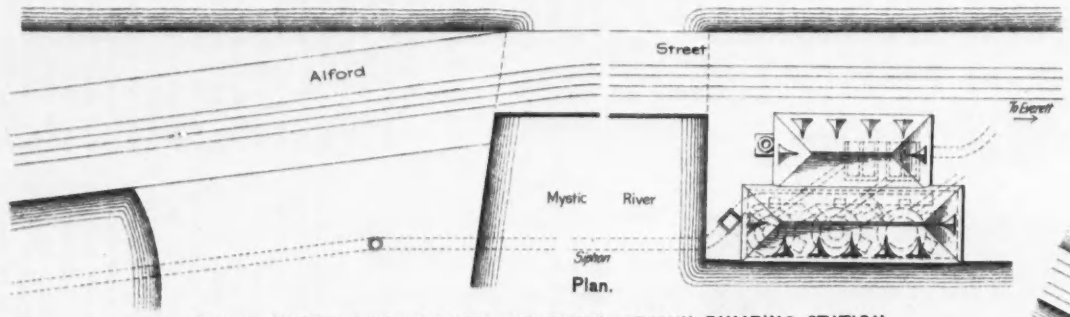
The method of bracing was to excavate the roof of exact shape and hold it by plates made of ⅛-in. steel curved to proper radius, 3 ft. long by 1 ft. wide. The edges of the plates were reinforced with 2-in. by ¼-in. angles, through which bolts were passed to fasten together adjacent plates. These were held up by spruce braces.

In the north heading the compressed air was used to remove the water, a 1½-in. iron pipe being carried through the lock and extended to the heading. Here an ordinary stop cock was provided and

* In a paper read before the Society of Arts, Boston, December, 1893, which will be published in the "Technology Quarterly."

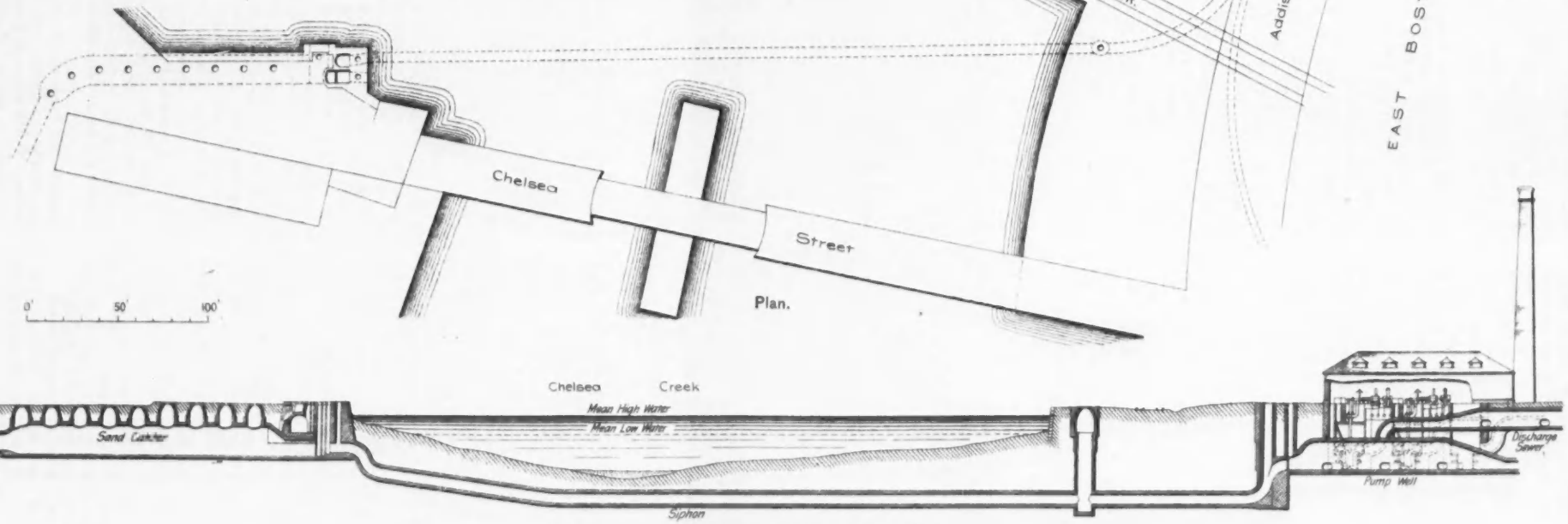


Section through Siphon and Pump Well.



Plan.

FIG 1. MYSTIC RIVER SIPHON AND CHARLESTOWN PUMPING STATION.



Plan.

Section through Sand Catcher, Siphon and Pump Well.

FIG. 2. CHELSEA CREEK SAND CATCHER, SIPHON AND EAST BOSTON PUMPING STATION.

Siphons, Sand Catcher and Pumping Stations, Metropolitan Sewerage Systems of Massachusetts.

Howard Carson, Chief Engineer; Hosea Kingman, Tilly Haynes and Harvey N. Collison, Commissioners.

DRAE, HART & BONS, LITH., 28 VESEY ST., N. Y.

a piece of suction hose attached to the pipe. On dropping the end of the hose into the water accumulated in the heading and opening the stop cock the pressure forced the water to the shaft. While driving the tunnel a No. 5 pulsometer pump, running about half the time, took care of all the water, the maximum amounts pumped per 24 hours being estimated at 580,000 gallons from the tunnel and 65,000 gallons from the shaft. The tunnel was lighted by incandescent electric lamps. The weekly average progress in tunnel under pressure was 24.8 ft.; in open tunnel from Shaft 1, 18 ft., and from Shaft 3, 13 ft. Extra payment was made to those in charge of tunneling when an average of 3 ft. per day per month was exceeded, as it was desirable to put in the plates as rapidly as possible to lessen possible trouble with the roof.

The siphon tunnel is 5⅔ ft. in diameter and 504 ft. long. There are connected with the tunnel a gate chamber and overflow, the gate well being 16×29×7 ft. and the overflow opening, 5×10 ft., and also a sand catcher 15 ft. 5 ins.×16 ft. 1 in. and 145 ft. long, with a reducer 10 ft. long from the sand catcher to the main sewer. The average depth of the excavation below the ground level at the shaft was 52.9 ft., the greatest depth, 58.2 ft., the average width 8 ft., the excavation per lineal foot of tunnel 2 cu. yds., and the approximate cost of excavation per lineal foot, including proportion of shaft, $50. The excavation was through hardpan, clay and boulders, gravel and clay, clay with a little silt and sand. The approximate cost of the tunnel per lineal foot of excavation and masonry, including proportion of shafts, was $70. The plant used here was similar to that mentioned above under the Mystic River tunnel, with the addition of an 8×14×12-in. Blake pump.

In constructing the sand catcher at Chelsea Creek a fine sand was found which was kept in a semi-fluid condition by water from an underlying gravel stratum. Thirty 2-in. pipes were therefore sunk into the gravel and by pumping from 12 or 14 of these at a time the ground water level was reduced from an elevation of 6 ft. to one of 32 ft. beneath the surface.

The sand catcher is supported on a platform of 4-in. spruce planks resting on 34-ft. piles (not shown in the section, Fig. 2), driven in bents, 4 ft. c. to c., cut to an arc of 30-ft. radius, capped with six pieces of 2×12-in. spruce fastened to each pile by ¾×24-in. driftbolts. The sand catcher is 151 ft. long and required 26 cu. yds. of excavation per lin. ft., at an average depth of 21 ft. The approximate cost of the excavation was $50 per lin. ft. A steam derrick, incline, pile-driver, 6-in. centrifugal pump, 8×8½×12-in. duplex pump and three small steam pumps were used in connection with this work.

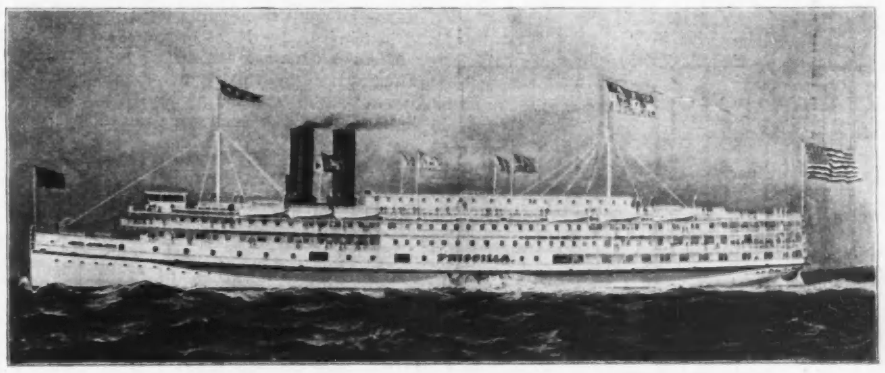
THE NEW STEAMER "PRISCILLA;" FALL RIVER LINE.

The latest addition to the fleet of large and handsome passenger steamers running on Long Island Sound is the "Priscilla," of the Fall River Line, which has recently been completed, and of which we present a view from a picture for which we are indebted to Mr. O. H. Taylor, Assistant Passenger Agent. The vessel is very similar to, but 20 ft. longer than, the "Puritan," of the same line (Eng. News, March 12, 1892), and has many improvements in design, while the old-fashioned type of vertical engine with a walking-beam has been abandoned in favor of double inclined compound engines, thus keeping the weight of the machinery well down in the hull, and leaving the main and upper decks unobstructed by inclosures for the machinery, while the new type of engine will give a steadier and more uniform motion and cause less vibration. The "Priscilla" is fitted with boilers of the Scotch or marine type, carrying 150 lbs. pressure, while the "Puritan," which is the next largest boat of the line, has Redfield boilers, and under the laws regulating steamboat boilers a pressure of only 120 lbs. could have been carried if this type had been used for boilers of the dimensions and power required for the new steamer. The "Priscilla" has also a larger passenger and freight capacity, and has a dining saloon on the main deck with seating capacity for 250 persons. There are five decks and the usual arrangement of saloons, staterooms, parlors, private dining-rooms, etc., all handsomely furnished and decorated in the style familiar to travelers on the Sound steamers. There are 347 staterooms, 14 parlorrooms, 35 officers' rooms, and 219 berths; also 89 berths for second-class passengers and 155 berths for the crew.

The hull is of steel, built on the double-hull longitudinal cellular system, with a double bottom 340 ft. long, having 52 watertight compartments. Besides this the hull is divided above the inner bottom and at the ends of the vessel by means of bulkheads extending to the main deck and by flats, into nine additional watertight compartments, making 61 compartments in all. The frames are spaced 2 ft. 6 ins. c. to c., while those of the "Puritan" are 2 ft. 2 ins. c. to c. The longitudinals, depth of floors, etc., are identical in both vessels, but in the deck construction there is a wide difference. The frame of the "Puritan" is carried double to the height of main deck and measures at the head 24 ins., is fitted with a clamp strake 48 ins. wide, to which the main deck beams are riveted, having welded knees 36 ins. deep at the ends, these beams being of T-bulb sections 11½ ins. deep and spaced 54 ins. c. to c. In the "Priscilla" the construction at this point is formed by frame and reverse bar riveted together in the usual way and having a gusset plate 24 ins. wide at top connecting it with a 27-in. lodger plate which extends from skin plating inboard, upon which the main deck beams, which are 12-in. I-beams spaced 45 ins. c. to c., are riveted. The frames also extend up through this lodger plate, every third one being riveted to the end of a beam. The main deck stringer, which amidship is 60 ins. wide, is riveted to the top flanges of the main deck beams and extends 18 ins. outside the hull, leaving a width of 42 ins. to be fastened to the beams. A large fore and aft angle on the outside of the sheer strake connects the same to the deck stringer, making the gunwale construction of this boat a very stiff and complete structure. At intervals of 15 ft. belts 24 ins. wide connect the frame, inner hull and deck compactly together, making with the floors, longitudinals, frames, stringers and deck beams one complete and substantial framework, upon which the outside or skin plating is placed and with the inner hull plating, which extends to a height at lowest point of 7 ft. 6 ins. above the keel, gives to the completed structure a compactness and strength necessary for a steamboat of such exceptional proportions, power and speed. There are two steel masts, steel wheel batteries and bulkheads, inclosed steel sponsons, etc. The hull was built by the Delaware River Iron Shipbuilding & Engine Works, of Chester, Pa., after the drawings and structural designs of Mr. R. T. Dickinson, Superintendent of the company, to whom we are indebted for the above details of the construction.

The steering arrangement is direct and complete. The rudder bumpkin cuts through the outside plating under the knuckle of the stern and is connected to the steering engine by means of tiller ropes which are held in position around the rudder stock by a steering wheel 21 ft. in diameter with central boss and two radial arms keyed to the rudder stock head inside the hull, the after side of this wheel being securely fastened to the rudder bumpkin, which swings in a watertight trunk on the inside of hull.

The main engine is of the double, inclined compound surface-condensing type, of 8,500 maximum horse power. There are two high-pressure cylinders, each 51 ins. diameter, side by side, forward of the main shaft, and two low-pressure cylinders, each 95 ins. diameter, side by side, aft of the main shaft, all having a stroke of 11 ft. The main engine shaft is in three sections, the two outboard ones having the driving, and the center section the drag cranks, there being two sets of cranks set at right angles. Each crankpin is connected to the connecting rods of a high and a low-pressure cylinder. Owing to the inclination of the cylinders, the connections of but one cylinder can be thrown upon a dead center at the same time, thus insuring a very steady and even rotation of the main shafts, an equal distribution of power and minimum vibration. Each low-pressure cylinder has its own air pump and surface condenser. The air pumps are vertical and are worked from the low-pressure crossheads, and there are two independent centrifugal circulating pumps for each condenser. The total cooling surface of the condensers is 16,000 sq. ft. The main steam chest valves are of the double poppet type, and are worked by double eccentrics and links. The high-pressure cylinders have adjustable drop cut-offs; and the low-pressure cylinders fixed Stevens cut-offs. The paddle wheels are of the feathering type, 35 ft. in diameter outside of buckets, and having 13 curved steel buckets in each wheel, each bucket being 5 ft. deep by 14 ft. wide.



STEAMSHIP "PRISCILLA," FALL RIVER LINE.

The ten main boilers are of the single-ended Scotch or marine type, and are built for a maximum steam pressure of 150 lbs. This is beyond what will be required for the usual business of the steamer, but is advantageous in permitting a large range of pressure. Each boiler is 14 ft. mean diameter by 14 ft. 6 ins. long, and contains three corrugated furnaces each 45½ ins. diameter, and 184 Serves' patent ribbed tubes 3½ ins. diameter. The boilers are fitted both for natural and forced draft under the grates, the forced draft being supplied by two large Sturtevant fans driven by independent engines. These steam fans are placed in the main engine department and serve also to ventilate the engine-room. The total grate area of boilers is 850 sq. ft. and the total heating surface is 35,400 sq. ft. The engines and boilers in general design, although 70% greater in power, are the same as those in the company's latest new steamer, the "Plymouth," which was put in commission in the autumn of 1890. An extra large donkey boiler and two large fire and wrecking pumps are on the main deck. The pumps are so arranged and connected that they may for all purposes work independently or together. There is also a large bilge pump in the engine department below deck, forming in all three complete wrecking and four very complete fire systems extending the full length and throughout the vessel. In addition, there are a number of hand pumps in various parts of the vessel.

The electric lighting arrangements are very elaborate and complete. There are 1,900 incandescent lamps of 16 c. p., the current for which is supplied

by three multipolar, direct-coupled, compound-wound dynamos, driven by horizontal Ideal engines, having cylinders 11 ins. diameter and 12 ins. stroke. The capacity of each dynamo is 400 amperes and 125 volts. Special care has been taken in the wiring of the vessel, and none but extra heavy wires with the very best fire and waterproof insulation have been used. There is a cold storage plant supplied with a two-ton Allen dense air machine.

The "Priscilla" was modeled and designed by Mr. George Peirce, Supervisor of the Old Colony Steamboat Co., and the contract for the ship and engines complete was given to W. & A. Fletcher & Co., of Hoboken, N. J., which firm built the engines and boilers and sublet contracts for other work. The hull was built by the Delaware River Iron Shipbuilding & Engine Co., of Chester, Pa. The joiner or woodwork, steam heating and plumbing were done by Wm. Rowland, of New York city, the plumbing and steam-heating fittings being supplied by H. C. & F. B. Calkins, of New York city. The thermostats were fitted by the American Fire Alarm Co., of Boston, Mass. The electric plant was furnished by the General Electric Co., and the electric bells, speaking tubes and engine bells by Chas. Cory & Sons. The cold storage plant was put in by H. B. Roelker, of New York city. The painting and decorating were done by G. R. Hutson, of New York city. The leading particulars and dimensions of the ship are given in the following table:

Steamer "Priscilla"; Fall River Line.

Length over all	440 ft. 0 ins.
Length on water line	424 " 0 "
Beam on water line	52 " 6 "
Width over guards	93 " 0 "
Depth	20 " 6 "
Draft, loaded	13 " 0 "
Displacement tonnage, loaded	5,200 tons
Engines, type	Double inclined compound
" HP.	8,500
Cylinders, two h. p.	4 ft. 3 ins. × 11 ft. 0 ins.
" two l. p.	7 " 11 " × 11 " 0 "
Paddle wheels, diameter	35 ft. 0 ins.
Boilers, type	Scotch or marine
" number, 10; H. P.	8,500
Grate area	850 sq. ft.
Heating surface	34,700 " "
Freight	800 tons
Coal	200 "
Passengers	1,400
Officers	12
Crew	195
Speed	22 miles per hour
Length of journey	181 miles
Time for trip, per schedule	10 hours
Coal consumption per trip	50 tons

The length of the journey is 181 miles between New York and Fall River, Mass., at which latter place connection is made with special express trains to and from Boston, 51 miles. The boats run every night, the schedule time being ten hours, while the rail trip is 1 h. 20 mins. The time on the all-rail routes between New York and Boston, about 260 miles, is about 5½ hours. A trial trip from New York to Newport, R. I., 163 miles, was made on May 10 in 8 h. 24 m., or 8 h. 4 m., deducting three stops made to adjust the steering gear. There was a head tide nearly all the way, and the boat had to run slowly through the river until the Sound was reached.

A NEW SYSTEM OF CONNECTING ENGINES AND DYNAMOS.

There are two important requirements which the engineer designing an electric power station must constantly keep in mind. First, the plant must operate with economy at any variation in load which endures for any length of time. Thus it may be admissible to overload the whole station and use steam wastefully to carry the station over the "bad quarter of an hour" when the demand for current is greatest, or it may be admissible to push everything to the top notch while some machine is idle for temporary repairs; but in general any load which is to be carried for any length of time must be carried as economically as possible. In the second place, whatever happens, the station must not shut down, and to meet this requirement a surplus capacity of engines and dynamos is necessary.

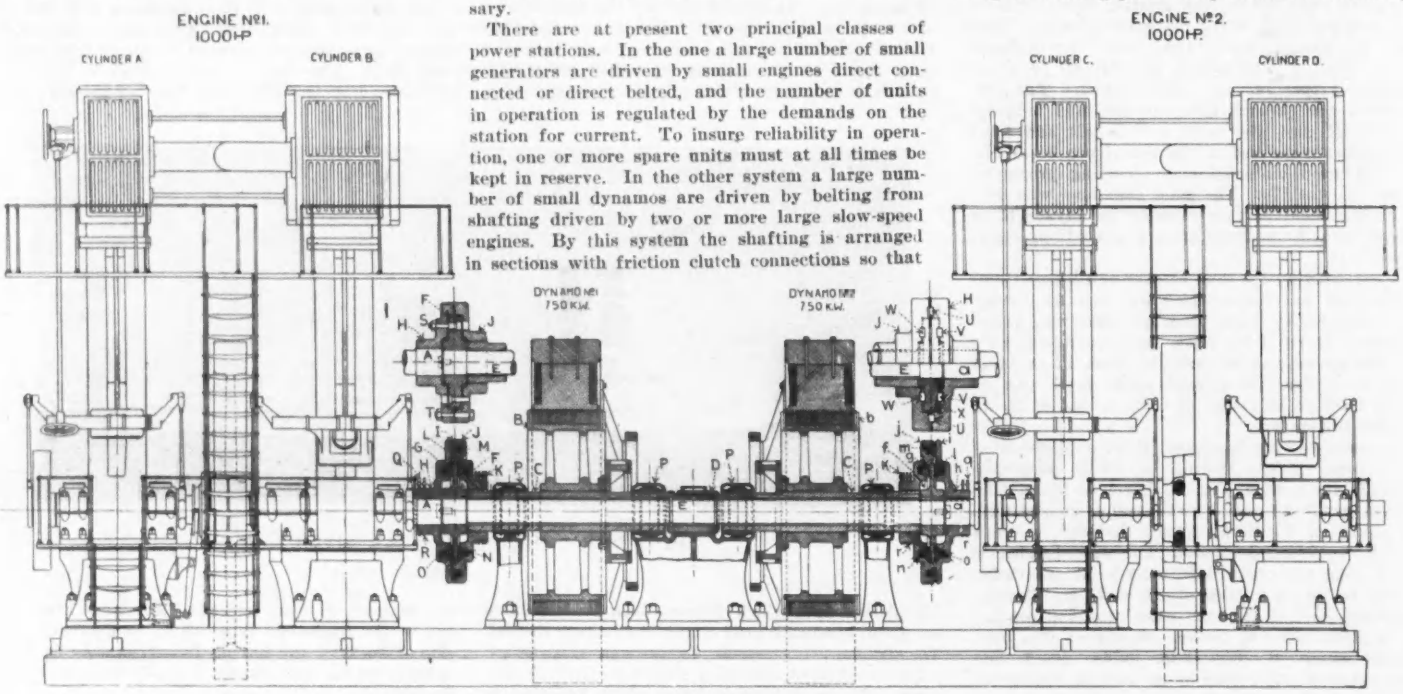
There are at present two principal classes of power stations. In the one a large number of small generators are driven by small engines direct connected or direct belted, and the number of units in operation is regulated by the demands on the station for current. To insure reliability in operation, one or more spare units must at all times be kept in reserve. In the other system a large number of small dynamos are driven by belting from shafting driven by two or more large slow-speed engines. By this system the shafting is arranged in sections with friction clutch connections so that any dynamo can be driven from either engine. The system of separate units is the cheapest in first cost, but the slow-speed engines with belting and shafts are generally considered to be the most convenient and reliable to operate.

We illustrate herewith a system of central power plant construction which seems to combine to some extent the advantages of both the old systems, and to be cheaper in first cost and more compact and flexible than any system now in use. The accompanying illustration represents the proposed arrangement of an electric railway station of 2,000 HP. capacity, which would have been sufficient to have operated the Intramural R. R. at the Columbian Exposition. The engines shown are supposed to be cross-compound, and while vertical engines are shown, horizontal might be used if preferred.

The armatures of the generators are mounted upon hollow cast steel shafts or quills, Cc, running in independent bearings, Pp, so arranged that they are free to revolve independent of either engine and of each other. Through these quills, and supported at its center by bearing D, extends a shaft carrying upon its ends circular cast steel or cast iron disks, Ff, securely keyed to the shaft.

The drawing shows the engines connected to the generators by magnetic clutches which operate as follows: Attached to the end of the engine shafts, Aa, are circular cast iron or cast steel of disks, Hh, near the peripheries, are carried cast which are connected to brushes, Qq, by means of rings, Rr, in such a manner as to permit a current of electricity to be passed through the coils while the disks are in motion. Around the vertical face disks, Hh, carrying in recesses copper coil Oo, steel or cast iron rings, Ii, which are held in position on disks, Hh, by means of three gudgeons or bolts, equally spaced around the periphery of disks, Hh. Rings, Ii, are normally held against disks, Hh, by small spiral springs surrounding the gudgeons or pins. Attached to quills, Cc, are cast iron or cast steel disks, Jj, carrying two coils of copper wire, Mm, Nn, which are connected to brushes, Kk, so as to allow a current to be passed through the coils when the disks are in motion.

It will now be noticed that if a current of electricity is passed through the coil, M, a magnetic field will be created around it which will have a tendency to attract disk I, overcoming the action of the springs which normally hold it against disk H, and clasping it securely to disk I, so that power can be transmitted from one disk to the other by friction so long as the current travels through coils, M. If engine No. 1 now be set in motion, it will drive generator No. 1 directly connected, there being no wearing parts except what are ordinarily



A NEW SYSTEM OF CONNECTING ENGINES AND DYNAMOS; B. J. Arnold, M. Inst. Elec. E., Designer.

encountered in a direct-connected engine and dynamo plant. In like manner engine No. 2 can be connected to generator No. 2, thus forming two direct-connected power units.

Shaft E lies idle in bearing D, and is not used except in case it becomes necessary to drive either generator from the opposite engine, or both generators from the same engine. In a direct-coupled plant having but two units of power wholly independent of each other, in case the engine of one unit and the generator of the other unit should become disabled, the plant would be at a standstill, and unable to furnish any current at all. With such an emergency as this, this new system would operate without trouble, and should one entire engine unit become disabled, both generators can be driven from either engine by simply passing the current through the proper coils.

It will be further observed from the illustration that the main shaft of each engine is cut in the middle and the two parts are joined together by means of positive jaw clutches, operated by a steam cylinder. Thus when the load is light, say, from 12 o'clock till morning on an elevated road, engine and generator No. 1 are shut down. Cylinder D of engine No. 2 is cut off by means of the jaw clutch, and no portion of the plant operates except the high-pressure cylinder of engine No. 2 direct coupled to generator No. 2. This cylinder can be run condensing and the plant operated with economy, until the road requires more power, when the low-pressure cylinder is brought up to speed and

connected with the high-pressure cylinder without stopping the plant.

In case it becomes necessary to make repairs on the high-pressure cylinder of engine No. 2 at the same time that the road is demanding the full power of engine No. 1, high-pressure steam may be admitted to the low-pressure cylinder of engine No. 1, which, as will be noticed from Fig. 1, is placed next to the generator. By working high-pressure steam in the low-pressure cylinder of this engine, it will give its full power, thus driving its generator and allowing the high-pressure side to be shut down for adjustment. Thus by having two engines with the high-pressure cylinder of one and the low-pressure of the other direct-connected to the work, the plant is arranged to operate economically with any load varying from 500 to 2,000 HP. and it is practically impossible to shut down the plant on account of any accident that would be liable to happen.

In order to prevent wear on the rings of the magnetic clutches above described, the following method of electrically starting the generators is proposed under this system: Suppose engine No. 1 and its generator are operating and engine No. 2 and its generator are standing idle, and it becomes necessary to throw generator No. 2 upon engine No. 1, in order to repair something on generator No. 1. Instead of starting engine No. 2 to bring generator No. 2 up to speed, or allowing the friction of the magnetic clutch to bring the latter up to speed, the following method is adopted: Current being produced from generator No. 1 is passed through the armature and fields of generator No. 2 in such a manner as to make a motor of it until the armature attains the same speed as that of generator No. 1, when current is passed through coil n clamping disk f to disk j without wear on the clutch mechanism.

In case it ever becomes necessary to increase the capacity of the power station designed under this system, it is done by adding two more generators to the right of engine No. 2, having similar connections to generators Nos. 1 and 2, thus making four generators available from engine No. 2. The third engine is added as the power is required.

The magnetic clutches while convenient are not essential of course to the system's operation. Mechanical clutches may be used if desired; and for a railway plant, where the station can be stopped for a few minutes at the time of changing from one engine to another, could probably be substituted without detriment.

The system of construction above described is admirably suited to the operation of an arc-lighting plant, where a large number of separate machines must be run to furnish currents for the separate circuits. Or a combined arc and incandescent system can be economically operated, a high-speed engine being direct connected to the shaft at each end and the shaft being divided in the middle so that either half of the station may be shut down to cool a hot journal without shutting down the other half. As before, the generators are mounted on quills carried in independent bearings, and motion is transmitted to the generator by means of positive jaw clutches. It will thus be noticed that when the generator is not running there is absolutely no wear upon the shaft, no side strain by the pulling of belts, or no friction clutch pulleys to get out of adjustment. The strain on the shafting is purely torsional, thus permitting it to be small in diameter and making it much less liable to get out of alinement.

When it is desired to start any generator, it is brought up to speed as a motor, and when it attains the same speed as the line shaft, a positive clutch, operated either by hand or by electricity, is thrown into connection, after which the current is reversed through the machine and it immediately becomes a generator.

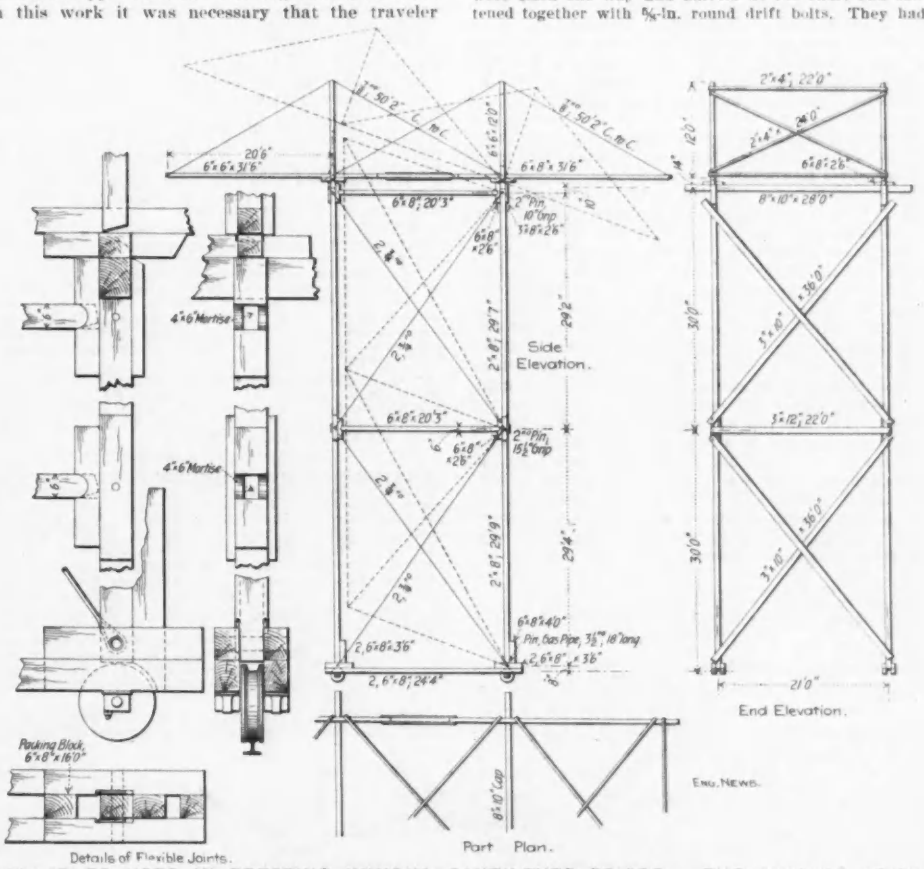
It will thus be noticed that any generator in the plant can be started and stopped at will, without stopping either engine, or without using belts, pulleys or friction clutches, thus having all the flexibility and reliability of the ordinary low-speed lighting station, wherein shafting and belting are used, and occupying not over one-quarter the amount of real estate that such a plant ordinarily covers. This permits a very much less expensive building to be constructed, less investment in real estate; greater ease in operation on account of having fewer wearing parts to lubricate, and less labor to operate the plant.

Another important feature of the system is the fact that any standard make of dynamos and engines can be utilized, thus necessitating no radical departure from the present lines of manufacture. For this reason many of the present plants can be rebuilt to conform to this system and utilize a large part of their old equipment.

The designer of this new system of engine and dynamo connection is Mr. B. J. Arnold, M. Inst. Elec. E., the designer of the power house for the Little Rock Street Ry., illustrated in our issues of Jan. 26 and Feb. 2, 1893, and the Consulting Engineer in charge of the design and construction of the Intramural R. R. at the Columbian Exposition.

ADJUSTABLE TRAVELER FOR ERECTING THE WINONA BRIDGE.

We illustrate herewith a novel traveler designed by Mr. Horace E. Horton, of the Chicago Bridge & Iron Co., and used in the erection of the four-span cantilever highway bridge constructed across the Mississippi River at Winona,, Minn., in 1892. In this work it was necessary that the traveler



TRAVELER USED IN ERECTING WINONA CANTILEVER BRIDGE; THE CHICAGO BRIDGE & IRON CO., CONTRACTORS.

should be capable of moving along a vertical convex curve corresponding to the curved bottom chord of two of the spans, and also be capable of running on a level. To enable it to do this and keep the posts vertical the framework was made with flexible connections. The details of these connections and the general method of adjusting the framework to suit the various angles are clearly shown by the drawings, and it need only be said that the traveler was successfully used in erecting the iron for the entire bridge 1,055 ft. long. We are indebted to Mr. Horton for the matter from which our illustrations have been prepared.

The committee appointed by the Chamber of Commerce of Duluth, Minn., to investigate the project of the Altamonte Water Co. for establishing dams and reservoirs for water power, has reported adversely to the project on the ground that it has not been sufficiently studied to warrant the construction of the works and that there do not appear to be sufficient financial resources.

RECONSTRUCTION OF A PORTION OF THE SUBSTRUCTURE OF THE JOHNSONVILLE BRIDGE.*

By Walter A. Gahagan.

This work (of which the writer was superintendent of construction under Hunter McDonald, chief engineer) consisted in the removal of three old piers and building two new ones for the portion of the bridge crossing the Tennessee River, on the Nashville, Chattanooga & St. Louis Ry., at Johnsonville, Tenn. The old piers were built in courses varying from 12 to 30 ins. in thickness. The face stone had been carefully cut and laid with headers and stretchers, and the backing filled in with rough stone, all laid without mortar of any kind, and the pier seemed to have stood remarkably well.

In the lower portion the high water filled the voids in the masonry with sediment. In the upper portions of the pier there had been during late years cement mortar and grout poured in, which assisted, in a measure, in binding this part of the masonry together. All of the piers had large cracks in them caused by unequal settlement. They were founded at low water upon rough timber cribs, which rested upon the gravel of the river bed. The cribs were from 6 to 7 ft. high, built from round logs of poplar and oak timber, which were sized one way and halved at the ends, and fastened together with ⅝-in. round drift bolts. They had been filled with rip-rap stone. Very large stone covering from 8 to 16 sq. ft. were laid in a course near the top. Most of the stone were found to be broken from unequal pressure, when they were removed. Three of the old piers were torn down, the crib and everything removed to a depth of 8 ft. below low water. All of the cribs had been protected by dumping rip-rap around them, which materially reduced the section of the river and caused scour. Within a few feet of bed rock this rip-rap had begun to interfere with the passage of boats through the draw. The drawspan had to be swung during construction on an average once or twice a day.

The proposals for the repairs required a new pivot pier in a changed position, and a new pier in place of one of the old piers. It also required that four of the spans be supported in such a manner as to admit of the passage of all trains and steamboats until the work was completed. The first plan was to erect two heavy trusses, one each side of the pier to be removed, and at right angles to the track. These trusses to be supported by pile piers to be driven far enough from the

* Abstract (from the Society's bulletin) of a paper read before the American Society of Civil Engineers, May 16.

old pier not to disturb the slope of the material upon which the old pier rested. They were also to be far enough away not to interfere with the sides of the caisson during sinking. This method was attempted at one of the piers, but after three or four piles had been driven, the top of the whole pier settled 4 ins. to the west, and it was not considered safe to do any more pile-driving near two of the old piers, which would disturb in any way the slopes of the mounds upon which they rested.

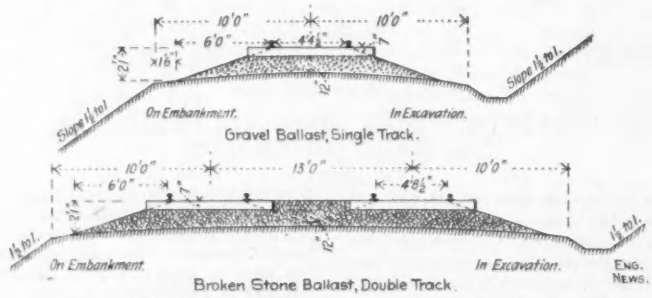
The trusses which were to support the bridge during these repairs were made of gum timber in lengths from 17 to 43 ft. The trusses were placed 15 ft. apart, and were 136½ ft. long over all. They were framed and erected before the timber had time to season; the seasoning took place, of course, afterward, and caused a good deal of trouble in tightening up bolts, etc. On account of the dead load of the whole span, together with the passage of a train every few hours, the shrinkage could not be taken up on the vertical rods, and the trusses sagged, so that the center was 5¾ ins. lower than the ends before the seasoning of the timber was complete. The same truss was made to do duty at two of the piers.

Two pneumatic caissons were used, one for the pivot pier, 36 × 36 × 16 ft., surmounted by a timber crib, 36 × 36 × 25 ft., filled with concrete. The smaller one for the new draw rest pier, 16 ft. 9 ins. × 40 ft. 6 ins. × 12 ft., surmounted by a timber crib, 16 ft. 9 ins. × 40 ft. 6 ins. × 29 ft., filled with concrete. Both cribs and piers had vertical sides. They were all built of oak, except a few long pieces used for ties and struts, which were of gum. The caissons were built upon the shore above the bridge and floated into position.

The depth of immersion was calculated as 8 ft. 1 in. above the bottom of the launching shoe, and the depth of the water into which the caisson was launched was 8 ft. 6 ins. It had a false bottom of 2 × 12 ins., poplar plank, which was tongued and grooved. As this was seasoned before using, the swelling, after it entered the water, made it quite tight by the time it was put in place, and the water was easily pumped out, to allow the floating of the caisson to position. After this was done, the material underneath was 14 ft. lower on one side than on the other, and on that side the caisson was suspended by two 4-in. screws from six piles, which were sway-braced one to the other. The weight on the suspended side was kept as light as possible until the cutting edge had a bearing over two-thirds of its surface. The material on which it landed was principally rip-rap, which was removed from the high side next the old pier, and deposited on the lower side opposite. The concrete was put on top only fast enough to keep its surface above water. This leveling up of the bottom consumed five days. The caissons were sunk through gravel and rested on bed rock, which was about 44 ft. below low water.

ROADBED CROSS-SECTIONS; C., C., C. & ST. L. RY.

A somewhat unusual cross-section of track with broken stone and gravel ballast is that adopted on the Cleveland, Cincinnati, Chicago & St. Louis Ry., as shown in the accompanying cut, taken from



CROSS-SECTION OF ROADBED; C., C., C. & ST. L. RY.

a blueprint for which we are indebted to Mr. Geo. W. Kittredge, Chief Engineer. Broken stone ballast as a rule is filled in level with the tops of the ties for the entire length of the ties and then either sloped down from the end or shouldered out for 3 to 12 ins. beyond the ends, but in this case it is sloped, like gravel, from inside the rails to the bottom of tie at the ends and thence to roadbed, the slope being much flatter than that usually adopted for stone. The gravel ballast is sloped in the same way, leaving the top flat for a width of over 4 ft., though it is more common practice to commence the slope near the middle of the track. On double track the gravel is sloped down between the tracks, leaving about 3 ins. of ballast at the lowest point.

CONSTRUCTION NEWS.

(Readers are invited to contribute items concerning new construction of interest to engineers or contractors for insertion in these columns. Those using these pages for information are informed that announcements of calls for proposals are inserted but once, and are not repeated from week to week.)

RAILWAYS.

East of Chicago—Existing Roads.

CANADIAN PACIFIC.—It is reported that this company has agreed to expend $100,000 within 1½ years and an additional $100,000 within 2½ years in extending the Montreal & Ottawa from Point Fortune, and that upon these conditions the time for the completion of the road has been extended to 5 years.

CINCINNATI, JACKSON & MACKINAW.—W. D. Williams, Ch. Engr., Van Wert, O., writes that surveys are about completed for the Cincinnati extension of this road and about two-thirds of the right of way secured. The route is from Franklin to Middletown; Middletown to Hagerman; Hagerman to Cincinnati; 42 miles, all in Ohio. The general average of the work is light, with the exception of a 7,000-ft. tunnel entering Cincinnati; no bridge to exceed 50-ft. span. It is not known when the contracts for the construction will be awarded. Isaac Dox, Cincinnati, is the engineer in charge of the extension.

LAKE SHORE & MICHIGAN SOUTHERN.—Press reports state that engineers are engaged in making a survey for an extension of this road from Andover, O., on the Franklin division, nearly due north to Conneaut Harbor. The line, as mapped out, will pass through Pierpont, Monroe, to the east of South Ridge, down to the Shenango-Curtis cut, and then parallel with the Pittsburg, Shenango & Lake Erie to the Appelby cut, near Conneaut Harbor, and then across the creek to the dock grounds, on the east side.

OHIO SOUTHERN.—R. L. Cobb, Ch. Engr., Springfield, O., writes to the "Railway Age" that the extension from Columbus to Cincinnati, O., will be 116 miles long, passing through Harrisburg, Sedalia, Jeffersonville, Allentown, Bowersville, Port William, McKay Station, Harveyburg, Oregonia and Lebanon. The company is building 20 miles with its own forces and no contracts have yet been let. Work is in progress between Jeffersonville and Waynesville and an effort to cross the tracks of the Cincinnati, Hamilton & Dayton at Allentown has been met with resistance from the latter road, which secured a temporary restraining order against the Ohio Southern.

PENNSYLVANIA CO.—A press report states as follows: The Pennsylvania Co., operating the Massillon & Cleveland, is reported, on the authority of P. G. Albright, a director of the M. & C., as now making preparations to tap the southwestern portion of the Massillon, O., coal district, and then extend the M. & C. from Clinton to Hudson, thus securing a direct outlet into Cleveland. Within the past few weeks a preliminary survey of the land between Clinton and Akron has been made.

PHILADELPHIA, NEWTOWN & NEW YORK.—At the annual meeting at Norristown, Pa., last week $600,000 in bonds were ordered to be applied to the construction of the Olney branch. Pres., Jas. Boyd; Secy. and Treas., Howard Boyd.

Projects and Surveys.

BEAVER MEADOW, TRESKOW & NEW BOSTON.—Frank N. Day, Hazleton, Pa., writes us that surveys are being made for this projected railway and that the right of way has been partly secured. The principal source of traffic will be coal. Pres., A. S. Van Wickle; Ch. Engr., W. L. Chamberlin, both of Hazleton, Pa.

CHICAGO, COLUMBUS & SOUTHERN.—Incorporated in Ohio to build a railway from Columbus to Athens; capital stock, $500,000; incorporators, W. R. Willcox, T. S. Young, Jr., Geo. C. Gormly, F. T. Adams, Cyrus W. Fisher, W. C. Lemert, and A. T. Wikoff. The first three named are New Yorkers and the others are residents of Ohio. The company states that it will offer the state $36,000 in advance and $9,000 per year rental for the canal property down the Hocking Valley.

CLEARFIELD, CONEMAUGH & WESTERN.—It is stated that the surveys are about completed for this road, noted March 29, and that the contracts for the construction will probably be awarded next month. Ch. Engr., Samuel Brugger, Fleming, Pa.

GRAND RIVER & MAHONING.—Jas. Ritchie, Pres. and Ch. Engr., 721 Hickox Bldg., Cleveland, O., writes us that work on this projected road was suspended last fall on account of the financial depression, options having been secured on about 50% of the right of way. Preliminary surveys and estimates were completed from Painesville, O., through Chardon, Burton, Garrettsville to Phalanx, 45 miles, and the line is projected but not surveyed for 76 miles bevond Phalanx. The work will be light, no rock, maximum curvature of 6° and ruling gradient of 35 ft. per mile. Source of traffic will be coal, ore, merchandise and farm products.

KNOXVILLE, FAIR HAVEN & MOUNT LEBANON.—Incorporated in Pennsylvania to build a steam railway between the villages named, in Allegheny county, a distance of five miles. Pres, Jas. F. Grimes, Knoxville, Pa.; Chas. W. Provost, Fair Haven, and A. H. Hunter, Knoxville, are directors.

PHILIPSBURG, EBENSBURG & JOHNSTOWN.—W. T. Forsythe, Ch. Engr., Houtzdale, Pa., writes us that surveys were commenced April 2 for this road, which is projected from Jeanesville through Coalport, Flynn City, Fallen Timber, St. Augustine, Chest Springs, Loretto, Ebensburg, Vinco and Conemaugh to Johnstown, 42 miles. The work will be light; maximum curvature of 10° and maximum grade of 1½%. The right of way is guaranteed in most part. The road is projected in the interest of the Altoona & Philipsburg Connecting. Pres., Sam'l P. Langdon, Bullet Bldg., Philadelphia.

RHINEBECK & RHINECLIFFE.—This company reported to have been organized to build a railway between the places named, in New York. The line will be 4 miles in length, and it is stated that nearly the entire capital has been subscribed by local capitalists. The construction is said to have been commenced.

Southern—Existing Roads.

CARRABELLE, TALLAHASSEE & GEORGIA.—Press reports from Tallahassee, Fla., state that surveys will be commenced at once for the proposed extension of this road, north from that city

CHATTANOOGA SOUTHERN.—J. W. Burke, Receiver, Chattanooga, Tenn., is said to have been granted permission by the court to build a branch line of this road to Round Mountain furnace in Alabama.

PENSACOLA, ALABAMA & TENNESSEE.—Henry McLaughlin, Pres., writes us that no work of importance has been done during the last 12 months, but that during the present year it is hoped to make some progress in extending this railway. The road is projected from Pensacola, Fla., to Memphis, Tenn., 430 miles. Ch. Engr., J. E. Dawson, Pensacola, Fla.

PETERSBURG.—Bids are asked until May 26 for the construction of six miles of new railway near Petersburg, Va. The work will include a large amount of temporary trestling and more than 4,000 cu. yds. of masonry. Engr., Maj. W. F. Gordon, Petersburg, Va.

PICKENS.—Julius E. Boggs, Pres., Pickens, S. C., writes us that Burkhalter, Grandy & Burkhalter, contractors for this road, state that the tracklaying will soon be commenced. The road extends from Easley to Pickens, nine miles.

Projects and Surveys.

TALLASSEE & COOSA VALLEY.—The Tallassee Falls Cotton Mfg. Co., Montgomery, Ala., is reported as organizing this company to build a railway from Montgomery north through the Coosa River Valley. About 15 miles of the line has already been surveyed. Ch. Engr., Col. Bradford Dunham, Montgomery, Ala.

Northwest.—Existing Roads.

BRAINERD & NORTHERN MINNESOTA.—This company has petitioned for a right of way through the Leech Lake Indian reservation, in Northern Minnesota.

CHICAGO, PADUCAH & MEMPHIS.—It is stated that Johnson Bros. & Faught, St. Elmo, Ill., contractors for this road, described April 19, have sublet contracts for grading to P. Fitzgerald, F. M. Johnson, John Burk, George Smith, James Austin, C. O. Faught, S. A. Campbell, C. S. Stocker, O. D. Ebey, and Brown Bros. The T. J. Moss Tie Co. has been awarded the contract for the ties, and M. S. Carter & Co., St. Louis, the contract for the depots, bridging and cattle-guards; also cypress tanks, tank stands, pumps, pump houses and stand-pipes for water stations. Ch. Engr., I. P. Reed, St. Elmo, Ill.

DULUTH, RED WING & SOUTHERN.—Wm. Danforth, Ch. Engr., Red Wing, Minn., writes us that there is no prospect of the projected extension to Albert Lea, Minn., being continued at present. Preliminary surveys have been completed from Red Wing by way of New Richmond, Balsam Lake and Clam Lake to Duluth, 170 miles.

DULUTH TRANSFER.—Day K. Smith, Pres., Duluth, Minn., writes us that this railway is projected from Duluth to Fond du Lac, Minn., by way of West Duluth and New Duluth, with a branch to Brace Junction and an extension to Superior, Wis., to connect at east end of bridge with Duluth-Superior Belt Ry.; main line 20 miles in length and branches 10 miles. About 20 miles of track is now in operation. The contracts are about all awarded, Foley Bros. & Guthrie, St. Paul, being the general contractors.

Projects and Surveys.

DUQUOIN & MURPHYSBORO COAL & RY.—Walter S. Hawkes, Ch. Engr., Duquoin, Ill., writes us that about 10 miles of this proposed railway was surveyed last year. The line will extend southwest from Duquoin and only about 14 miles is projected at present. The construction will probably be done by the company, and will be commenced as soon as the times improve sufficiently.

Southwest.—Existing Roads.

ATCHISON, TOPEKA & SANTA FE.—A press report from Wellington, Kan., states as follows: The contract was let May 11 for grading the extension of the Southern Kansas branch road to Hunnewell, Kan., and from that place to Rock Falls, by way of Parker, Okla. The Atchison, Topeka & Santa Fe will iron the road and operate it as soon as the grade is completed. This extension is but the beginning of the building of the road to Cross, Okla.

HOUSTON, EAST & WEST TEXAS.—It is stated that this railway, extending from Houston, Tex., to Shreveport, La., 232 miles, will be changed to standard gage in the near future. Gen. Man., M. G. Howe, Houston, Tex.

KANSAS CITY, PITTSBURG & GULF.—The capital stock of this railway company has been increased from $3,000,000 to $10,000,000 for extending the road south from Siloam Springs, Ark. Ch. Engr., J. H. Collins, Kansas City, Mo.

LITTLE ROCK, HOT SPRINGS & TEXAS.—The commencing of the construction of this railway in Arkansas was noted in our issue of April 26. Uriah Lott, the projector, is reported as stating that he has awarded contracts for 125 miles of steel rails, 1,500 tons to be delivered at Benton, the present eastern terminus, on the 15th of every month, and that he has purchased two Baldwin locomotives to be delivered June 15. Amended articles of incorporation have been filed providing for a main line of 190 miles and 160 miles of branches.

MISSISSIPPI RIVER & BONNE TERRE.—Contracts will be awarded in a few days, according to

reports, for the construction of 27 miles of this railway, from Riverside to Forest Station, Mo. The line is estimated to cost about $14,000 per mile. Ch. Engr., Jas. Lyman, Doe Run, Mo. Gen. Supt., J. Burns, Bonne Terre, Mo.

SPRINGFIELD, YELLVILLE & WHITE RIVER.—F. O. Hadley, 918½ Main St., Kansas City, Mo., is reported as reorganizing this company with a view to resuming the construction of the road.

Projects and Surveys.

KANSAS, OKLAHOMA & SOUTHWESTERN.—It is reported that contracts will soon be awarded for constructing this railway. The first section of the road will be built from Caneyville, Kan., to Guthrie, Okla. Pres., Robt. Martin, Guthrie, Okla.

LOUISIANA.—A company is reported as being organized at Kenner, La., to build a dummy line from that place to Carrollton.

NORTH ARKANSAS.—Franklin Duff, Pres., Union Trust Bldg., St. Louis, writes us that the preliminary survey has been made and right of way secured for this projected railway from Corning, Ark., through Reyno, Randolph county, to Current River, 18 miles of main line. The work will be light with easy curves and a maximum grade of 1%. The route is mostly through timber land. The delay in awarding contracts for the construction has been caused by the continued business depression.

SAN ANTONIO & GULF SHORE.—Press reports state that the construction of this railway was commenced at San Antonio, Tex., May 10, and that it is intended to have the line completed as far as Yoakum in time to handle the fall crop from that section. Massey & Co., Kansas City, are the contractors, as stated in our issue of April 12.

SPRINGFIELD, SEDALIA, MARSHALL & NORTHERN.—O. A. Crandall, Pres., Sedalia, Mo., writes us that this railway is intended to form one link in a direct line from Duluth to the Gulf. The survey has been made and all estimates completed. The line extends from Springfield through Buffalo, Cross Timbers, Warsaw, Sedalia and Marshall to Miami, 184 miles. The grading will be light, curvature not exceeding 5°. There will be a 500-ft. bridge but no tunnels. About one-fourth of the right of way has been obtained and a local aid of $300,000 subscribed, payable upon the completion of the road. Negotiations are now being made for other capital

TEXAS.—Press reports from Corsicana, Tex., state that the Commercial Club of that city has accepted a proposition of W. C. Coykendall to build a railway from the city to Buffalo to connect with the International & Great Northern, the city to subscribe $75,000 toward the road. Four of the nine directors of the new road will be F. C. Gaffney, of New York, Jeff C. Gibbons and J. A. Woodbury, of Chicago, and Z. W. Halferty, of Fairfield, Ia. Three of the five Texas directors are to be Corsicana men, and Kountz Bros., New York, are to be trustees for the bonds. Construction is to begin in 30 days after preliminaries are completed, the road to be bonded for not over $12,000 per mile and no money to be paid on bonds until ten miles are built and equipped.

Rocky Mt. and Pacific—Existing Roads.

CANADIAN PACIFIC.—Press reports state that the Columbia & Kootenai road will be extended from Nelson, B. C., about five miles south to Five Mile Point, to a connection with the northern terminus of the Nelson & Fort Sheppard.

GREAT SALT LAKE & HOT SPRINGS.—It is stated that work will be commenced at once on the extension north of Bountiful, Utah. Pres., S. Bamberger, Salt Lake City.

NEVADA SOUTHERN.—R. B. Burns, Ch. Engr., Williams, Ariz., writes us that this road is in the hands of a sheriff and that there seems to be no prospects of resuming construction very soon.

SANTA FE, PRESCOTT & PHOENIX.—G. W. Vaughan, Vice-Pres. and Ch. Engr., Prescott, Ariz., writes us that 60 miles of this railway is open for traffic; 83 miles of track have been laid, 91 miles graded, and the entire line surveyed and the right of way secured. The route is from Ash Fork, Ariz., on the Atlantic & Pacific, through Prescott, Skull Valley, Kirkland Valley, Congress, Wickenburg, Peoria, and Glendale to Phoenix, 196 miles. B. Lantry & Sons are the contractors for the grading.

SOUTHERN PACIFIC.—In addition to the letter of William Hood, Ch. Engr., published last week, the San Francisco "Examiner" states as follows concerning the proposed extension to Elwood, Cal.: The Southern Pacific R. R. Co. has already arranged for the commencement of work on the extension of its line now completed to San Luis Obispo, and which is to end at Los Angeles, ultimately to be the overland route of this railway. The plan of the company is to build to Santa Ynez by way of Lompoc, the route traversing Prince's Canyon, Grover, Oceano and Shuman Canyon to Santa Ynez crossing, which is 5½ miles from the ocean. The Pacific Coast railway track will be crossed at Maxwelton, six miles south of San Luis Obispo. On March 28, the company entered into a contract with the firm of Stone & McUrtis, a reorganization of the firm of George Stone & Co., to build this piece of road. The work is to begin at once. Mr. Huntington says the progress of the work will now depend on how the money comes in. Higbe & Bernard and Chas. Erickson will be the chief subcontractors on the work.

Projects and Surveys.

MONTEREY & FRESNO.—P. P. Dandridge, Ch. Engr., Monterey, Cal., writes us that contracts for constructing this railway will probably be awarded about June 1. This is projected as an independent road from the Bay of Monterey, 94 sailing miles south of San Francisco, to the Great San Joaquin Valley, in the interior of the state. The route is from Monterey to Salinas and over the Gabilan Mountains to San Juan, to Hollister and over the coast Range Mountains to Firebaugh, Madera and Fresno, 170 miles. The work will include four bridges and eight tunnels, none over 1,000 ft. in length. The right of way has all been obtained and a bonus of $1,000 per mile. The route from Monterey to Hollister, 46 miles, has been permanently located, and the location of the remainder of the route is in progress.

WYOMING & UTAH.—C. A. Sherman, Pres., Boone, Ia., is reported as stating that the prospects are most encouraging for the construction of this railway from Casper, Wyo., to Ogden, Utah, in the near future.

Foreign.

MONTEREY & MEXICAN GULF.—Press reports from Monterey, Mex., state as follows: J. A. Robertson, Gen. Man., and Receiver, has returned from New York, and it is announced that work will begin immediately on the extension of the line to Sierra Mojada. The line will eventually be extended from Sierra Mojada to the port of Mazatlan on the Pacific coast. The International road has secured the right of way into Monterey, and negotiations are now in progress for a depot site.

STREET AND ELECTRIC RAILWAYS.

BANGOR, ME.—An electric railway is proposed between this city and Stockton Springs, and it is thought that it will be constructed as far as Frankfort this year.

CALAIS, ME.—The contract for constructing the street railway has been awarded to the Worcester Construction Co., at $125,000. The road will be about eight miles long.

BROOKLYN, N. Y.—The contract for the concrete foundation for the power house of the Nassau Electric R. R. Co. has been awarded to P. J. Carlin, at $35,000.

GRAND ISLAND, N. Y.—J. H. Small has secured the right of way for an electric railway to make the entire circuit of the island. The construction will be commenced in two weeks, 1½ miles to be finished by July 1, 6 miles by June 1, 1895, and the entire line by June 1, 1896.

CORTLAND, N. Y.—The Cortland & Homer Horse R. R. Co. has been granted a franchise to change its motive power to electricity.

HIGHLAND, N. Y.—Burhaus Van Steenburgh has secured the necessary capital for the construction of the proposed electric railway between this place and New Paltz, according to reports.

NIAGARA FALLS, N. Y.—It is reported that J. W. Hoffman and C. A. Sims, of Philadelphia, are investigating the question of constructing a two-track electric railway from here to Buffalo, in the interest of the Pennsylvania R. R.

SAND LAKE, N. Y.—The Troy & New England Ry. Co. has applied for a franchise for an electric railway to this place.

VINELAND, N. J.—The Midland Improvement Co. has been incorporated with a capital stock of $100,000, to build and operate an electric railway. C. H. Love, Moorestown, is interested.

BUTLER, PA.—The Butler Traction Co. has been incorporated with a capital stock of $75,000; Pres., Joseph Hartman.

LOCK HAVEN, PA.—The survey for a proposed electric railway has been completed by R. H. Irvine.

NORRISTOWN, PA.—The Norristown & Chestnut Hill Passenger Ry. Co. has been granted a franchise to construct an electric railway in this place.

PHILADELPHIA, PA.—J. J. Sullivan, 1705 Spring Garden St. is president of the following street railway companies, incorporated May 10: Citizens' North End St. Ry. Co.; capital stock, $36,000; Citizens' Clearfield & Cambria St. Ry. Co., capital stock, $6,000; Brown & Parrish St. Ry. Co., capital stock, $15,000; Citizens' East End Passenger Ry. Co., capital stock, $15,000.——The Central Electric St. Ry. Co. has been incorporated with a capital stock of $60,000; Pres., Lewis G. Dutton.

PITTSBURG, PA.—The Sylvan Ave. Ry. Co. has been incorporated with a capital stock of $2,000; Pres., J. D. Callery.——The right of way has been secured for building an electric railway to Castle Shannon. The Knoxville & Fair Haven Land Co. is said to be the chief promoter of the road, which it is stated will be operated by the Birmingham Traction Co.

AKRON, O.—The Akron St. Ry. Co. has applied for a charter to build an electric railway from here to Barberton, a distance of six miles.

CINCINNATI, O.—The Cincinnati Marine Ry. Co. has been incorporated with a capital stock of $50,000.

LIMA, O.—It is reported that capitalists of this place and Fort Wayne are organizing a company to build an electric railway from this city through Wapakoneta, New Bremen and Celina, a distance of 40 miles.

XENIA, O.—Right of way is being secured by Wayne Neff, Cincinnati, for an electric railway from this place to Yellow Springs.

FORT WAYNE, IND.—The Centlivre St. Car Co. has applied for a franchise.

CHICAGO, ILL.—The Co-operative Electric Ry. Co. has been incorporated; capital stock, $1,000,000; incorporators, M. S. Evinger, C. E. Burnap, I. T. Dyer.

OSHKOSH, WIS.—The Inter-Urban Electric R. R. is reported as assured between this place and Kankanna. The cost will be about $350,000.

CHEROKEE, IA.—W. H. Noyes, Pringhar, has petitioned the council for a franchise for an electric railway.

HANNIBAL, MO.—The council has granted a franchise for the electric railway extension to Indian Mound Park, a distance of two miles.

ST. LOUIS, MO.—The St. Louis & Kirkwood Ry. Co. has awarded the contract for its proposed line to Meramec Highlands to the Suburban Construction Co. at $150,000, according to reports.

CLAYTON, MO.—It is reported that the Forest Park & Clayton Electric Ry. Co. is preparing to equip and operate its line in a short time.

PINE BLUFF, ARK.—The Citizens' St. Ry. Co. has been reorganized and the motive power will be changed to electricity. Pres., J. M. Taylor; Treas., John O'Connell; Secy., Arthur Murray.

DALLAS, TEX.—The Dallas & Fort Worth Rapid Transit Terminal Ry. Co. has been sold to H. C. Scott, St. Louis, Mo., for $90,000; also the West Dallas Ry. for $19,000. The motive power of the roads will be changed from steam to electricity, and it is thought probable that both lines will be extended to Fort Worth.

ELEVATED RAILWAY.

MONTREAL, QUE.—The Montreal Island Belt Line Co. has asked authority to build an elevated railway around the island and through the city, a total length of 60 miles.

HIGHWAYS.

OHIO.—Bids are asked until May 25 for macadamizing 11,100 ft. of road, the work including 65,723 cu. yds. excavation, 20,820 lin. ft. 4-in. curb, 12,822 cu. yds. broken stone, 2,564 cu. yds. screenings, 22,200 ft. 6-in. drain tile, etc. Henry J. Carens, Audr. Franklin County, Columbus.

MICHIGAN.—Bids are asked until May 31 for the sale of $100,000 of 5% Alpena county road bonds. A. J. Simmons, County Clk., Alpena.

MISSOURI.—Several citizens of Independence, Jackson county, are petitioning for the construction of a macadamized road from Raytown Boulevard to Lone Jack.

ARKANSAS.—Bids are asked until June 18 for the construction of a turnpike road from Consumers' Oil Mill to Fourche Dam. W. A. Compton, County Judge, Little Rock.

COLORADO.—The Ouray Toll Road & Railroad Co. has been incorporated by William Story, Theron Stevens and Walter F. Wheeler, to build a road up Red Mountain and Poughkeepsie Creek. It may be ultimately converted into a railway.

BRIDGES AND TUNNELS.

PROVIDENCE, R. I.—Bids are asked until May 22 for the construction of an iron highway bridge of 26 ft. span, with a driveway of 34 ft. and two 8-ft. sidewalks. Robt. E. Smith, Constr. Pub. Wks.

WOONSOCKET, R. I.—The Hamlet Ave. bridge commission has awarded the contract for a bridge over the Blackstone River to Dean & Westbrook, at $177,900. The bridge will be 524 ft. in length and have three piers. The bids were as follows: For a wrought iron deck bridge, Toledo Bridge Co., $195,530; Wrought Iron Bridge Co., $206,400; Massillon Bridge Co., $208,200; Berlin Iron Bridge Co., $193,600; R. F. Hawkins Iron Wks., $212,650; Dean & Westbrook, $192,240 and $177,900; Penn Bridge Co., $214,700, including paving; Groton Bridge Co., $198,340. For a stone arch bridge, W. H. Ward, Lowell, Mass., $296,000; Victor Allaire, Woonsocket, $305,536; Kenneth McKay, Valley Falls, $270,432; L. F. Kittredge, Lowell, Mass., $335,000.

ALBANY, N. Y.—The governor has signed bills appropriating $10,000 toward a $15,000 bridge to be erected at Lockport; $12,000 for a bridge in Fairport; $13,000 for a wrought iron bridge at Pickardsville; and $7,000 for a bridge in Mechanicville.

BETHLEHEM, PA.—It is stated that the Lehigh Valley Traction Co. has offered to give $25,000 toward a free bridge and that a meeting of the citizens has been called to consider the question.——The commissioners of Lehigh and Northampton counties have voted to strengthen the Broad St. bridge, which has been found unsafe.

MERCER, PA.—Bids are asked by the county commissioners until May 22 for the stonework of eight bridges. R. G. Madge, Clk.

PITTSBURG, PA.—The director of public works is reported as stating that bids for the construction of the proposed free bridge will be received as soon as the plans have been approved by the secretary of war.

SHARPSBURG, PA.—The Sharpsburg & Lawrenceville Bridge Co. is considering an increase of its capital stock from $79,000 to $200,000 to erect a new bridge in place of the present one.

BALTIMORE, MD.—The contract for building the Edmondson Ave. bridge has been awarded to the Youngstown Bridge Co., at $21,194. R. H. Hood bid $22,970, Campbell & Zell Co., $24,997, and Sanford & Brooks, $26,925.

CHESTERTOWN, MD.—The engineer employed to examine the old bridge across Chester River has reported that $9,400 will be required for a new superstructure and $8,600 for a substructure.

WILLIAMSPORT, MD.—Press reports state that Nelson & Buchanan, Chambersburg, Pa., have taken measurement for a new stone bridge which a syndicate proposes building across the Potomac River at this place. The bridge will be nearly 1,000 ft. long and is estimated to cost $30,000.

BREWTON, ALA.—The county commissioners are reported to have located a site for the construction of an iron bridge across Murder creek, near this place.

BRYAN, O.—Bids are asked until May 28, for the construction of a steel bridge to be erected over the St. Joe River in Superior township. A. C. Marshall, Audr. Williams County.

CINCINNATI, O.—The county commissioners have awarded the contract for the Llewellyn St. bridge to N. Reubel, at $11,475. C. Seyfried was the lowest bidder, at $11,270, but in the opinion of the engineer he is unable to do the work, for the reason that he has had no experience.

CLEVELAND, O.—The house has passed a bill authorizing the commissioners of Cuyahoga county to issue $60,000 in bonds for a bridge over the Chagrin River at Bentleyville.

RED WING, MINN.—The contract for the substructure of the bridge to be erected across the Mississippi River in this city has been awarded to D. D. Smith, St. Paul, at $16,771, according to reports. There were 17 bids received.

KANSAS CITY, KAN.—Bids are asked by the county commissioners until June 2 for the proposed new bridge across the Kaw River at Turners. Press reports state that it is to be an iron highway bridge with four spans resting on four masonry piers, one abutment and 440 lin. ft. of piling on the north side. The spans will be 198 ft. long and 30 ft. high between the piers. It will have a clear roadway of 20 ft. Estimated cost, $53,000.

BRANTFORD, ONT.—Bids are asked by the council until May 28 for an 80 or 88-ft. bridge over Whiteman's Creek, the contractor to furnish plans.

WATER-WORKS.

AUBURN, ME.—The contract for laying the pipe for the extension and improvement of the works has been awarded to Bearce & Clifford, Lewiston, at $32,000.

MECHANIC FALLS, ME.—The committee is reported as in favor of purchasing the Page's Mills water privilege, on the Little Androscoggin, about a mile from the village, for furnishing the town with water and electric lights; estimated cost of works, $52,400.

PITTSFIELD, ME.—The town has voted $1,200 a year for 20 years to the local company, and the construction of the works is expected to be commenced at once.

NEWMARKET, N. H.—The town has voted to grant a franchise and to contract for 50 hydrants at $2,000 a year. The works will be put in at once, according to reports.

DALTON, MASS.—The commissioners will commence work within a few days upon a new reservoir to cost about $6,500.——The citizens have voted to issue $10,000 of additional bonds.

MILLIS, MASS.—E. J. Stewart is a member of a committee appointed to investigate the question of purchasing the works and electric light plant.

NORTHAMPTON, MASS.—The contract for constructing the masonry dam for the new reservoir at Leeds has been awarded to Chas. Wellington, of Oxford, and Mr. Coyne, of New York, at about $40,000 The dam is reported as to be 400 ft. long, 45 ft. high and 28 ft. wide at the bottom.

ROCKPORT, MASS.—Bids are asked by the commissioners until May 21 for a wrought iron 30 × 60-ft. stand-pipe and for laying about 45,000 lin. ft. of 10 to 6-in. pipe. Bids for the pipe were received until May 15. Engr., E. Worthington, Jr., & Co., 53 State St., Boston.

HOPE, R. I.—Surveys are being made for works, according to reports, the supply to be taken from the reservoir at Fisherville.

NEW CANAAN, CONN.—The New Canaan Water-Works Co. is reported as about to build a dam in the Five-Mile River, about 2½ miles above the borough center; estimated cost, $50,000.

NORFOLK, CONN.—Bids are asked until June 14 for constructing works, as stated in our advertising columns. Edmund Brown, Secy.

DAVENPORT, N. Y.—The Davenport Water Co. has been incorporated with a capital stock of $10,500.

DOWNSVILLE, N. Y.—Works will be put in this summer, according to reports.

GLENS FALLS, N. Y.—The trustees have voted to sell the $80,000 in bonds authorized last year and to take steps to secure an iron main from the lower reservoir to the present iron main.

HUNTER, N. Y.—There is talk of works.

JOHNSTOWN, N. Y.—The committee has reported plans for an increased supply; estimated cost, $25,350 to $37,330. M. S. Northrup, Com. Com.

NEWARK, N. Y.—It is reported probable that the asylum will put in private works, owing to trouble with the water company.

NEW YORK, N. Y.—Edward Kemp, E. D. Adams, Cornelius N. Bliss and others have incorporated the Rumson Improvement Co., of the District of Rumson, N. J., to construct water-works, electric plants, etc.; capital stock, $40,000.

PENN YAN, N. Y.—Bids are asked until June 6 for constructing works, as stated in our advertising columns. Engr., Walter F. Randall, Syracuse. W. N. Wise, Secy. Comrs.

TROY, N. Y.—An expert has reported that the boilers in the Lansingburg pumping station should be replaced.

WEST TROY, N. Y.—The secretary of war is reported as favoring an independent supply for the Watervliet Arsenal; estimated cost, including two sand filters, $11,859.

ASBURY PARK, N. J.—The contract for a filter plant has been awarded to the Continental Filter Co., New York, at $20,000.

FREEHOLD, N. J.—Bids are asked until June 2 for a turbine water-wheel and a water-power pump, as stated in our advertising columns. N. J. Conover, Engr.

MILLVILLE, N. J.—The council has voted to ascertain upon what terms the local plant can be purchased or a new one constructed. About 16 years ago the city issued $37,000 in bonds to aid the Millville Water Co. in erecting its plant, receiving in return a perpetual water right. The city has grown so that 60 additional hydrants are now needed and the company refuses to put these in unless $50 annual rental is paid for each new hydrant.

NEWTON, N. J.—An election will soon be held, according to reports, to vote on the question of supply.

BLOOMSBURG, PA.—The officers of the Bloomsburg Water Co. are visiting other cities looking for improved machinery for the works.

BRADFORD, PA.—Bids are asked until May 21 for 11,180 ft. 6 and 4-in. pipe, 16 hydrants, 34 gate valves, etc.; also for trenching and pipelaying. E. N. Hallock, Secy. Comrs.

EPHRATA, PA.—The bill granting a franchise to the Ephrata Water Co. has been vetoed by the burgess, who has secured an injunction restraining the company from laying its pipes.

GREENCASTLE, PA.—The Consumers' Water-Works Co. has awarded the contract for works to H. A. Birkinbine, Philadelphia, at $27,000, the plant to be completed by Aug. 1.

HARRISBURG, PA.—The Paxtang Land Co. is reported as arranging to put in works for the residents of Paxtang.

WILKES BARRE, PA.—A committee has been appointed to investigate the question of a filter plant.

SNOW HILL, MD.—The citizens have voted, 223 to 38, in favor of issuing $18,000 in bonds for works.

WESTON, W. VA.—The Weston Water-Works Co. has been incorporated by G. A. McCormick, Robt. Umbel and others, Uniontown, Pa.; Chas. W. Swisher, Weston; capital stock, $40,000.

VALDOSTA, GA.—The water-works bonds have all been sold at par.

MOBILE, ALA.—The council is considering the advisability of purchasing the works.

SHREVEPORT, LA.—W. D. Scofield is a member of the committee appointed by the council to consider the question of purchasing the works.

DANVILLE, KY.—Bids are asked by the council until June 26 for the purchase of the $70,000 of water-works bonds.

HOPKINSVILLE, KY.—A vote is to be taken on the question of putting in works, and an engineer will probably be engaged to design a system.

PRINCETON, KY.—The "Banner" states that A. B. Sanders, representing Louisville capitalists, has offered to put in works and an electric light plant if the city will pay $1,500 per year for 34 fireplugs and $1,000 for 10 arc lights.

ARLINGTON HEIGHTS, O.—J. T. Hall, Clk., writes us that the question of issuing bonds for works was defeated at the spring election.

GALLIPOLIS, O.—The special election resulted 612 in favor to 24 against works, and the mayor has been instructed to sell the $85,000 of water-works bonds to Spitzer & Co.

MILFORD CENTER, O.—Bids are asked until May 26 for works and an electric light plant. J. G. Bennett, Village Clk.

NAPOLEON, O.—An election was held May 14 to vote on the question of works and electric lights.

WAPAKONETA, O.—Bids are asked until May 21 for constructing proposed works. Joseph Myers, Village Clk.

YOUNGSTOWN, O.—Bids are asked until May 29 for two 5,000,000-gallon pumping engines and for two 30 × 100-ft. steel stand-pipes, as stated in our advertising columns. W. S. Hamilton, Supt.

ALEXANDRIA, IND.—Bids are asked until May 28 for constructing works on a 25-year franchise plan, as stated in our advertising columns. Consult. Engr., Geo. W. Sturtevant, Jr., Chamber of Commerce Bldg., Chicago. Pink Varble, Chn. Com.

EAST CHICAGO, IND.—The contract for works has been awarded to the Seckner Contracting Co., Chicago, at $98,000. This item was published by mistake under Chicago, Ill., in our issue of May 3.

TIPTON, IND.—Bids are asked until May 31 for constructing works, as stated in our advertising columns. Engr., J. F. Witmer, Buffalo, N. Y.; Lee Nash, Secy.

WHITING, IND.—J. H. Brown, Secy., Seckner Contracting Co., Chicago, writes us that we were misinformed as to the item from this place last week and that no water-works are to be constructed at this place.

CHESANING, MICH.—E. T. Long is a member of a committee appointed to investigate the question of works and an electric light plant.

KALAMAZOO, MICH.—The trustees have rejected all the bids for erecting a water tower at the asylum, the bids being in excess of the appropriation.

EDWARDSVILLE, ILL.—The City of Edwardsville Water-Works Co. has been incorporated with a capital stock of $30,000.

FARMINGTON, ILL.—Bids are asked until June 1 for constructing works, as stated in our advertising columns. Engr., Chas. F. Sturtevant, St. Louis. W. H. Miller, Mayor.

MOLINE, ILL.—The mayor has recommended extensions of the mains in several districts.

WHEATON, ILL.—We are informed that works will be put in. Gray Bros., Milwaukee, Wis., have been awarded the contract for sinking a well, and contracts are to be let for erecting a 16 × 100-ft. stand-pipe and establishing a pumping plant of about 500,000 gallons daily capacity. C. A. Prout, Cy. Surv.

DODGEVILLE, WIS.—The citizens have voted to issue bonds and put in works.

EDGERTON, WIS.—Mayor Heddles is a member of the committee investigating the question of works.

JANESVILLE, WIS.—Press reports state that the council has taken steps to secure works. The present works were built in 1887-8 by the Janesville Water Co.

TOMAH, WIS.—It is reported that an election will be held to vote on the question of works.

RED OAK JUNCTION, IA.—Bids are asked until May 22 for constructing works, including 20 × 100-ft. iron stand-pipe and 1,000,000-gallon pumping engine. Engr., F. L. Burrell, Fremont, Neb. R. O. Newell, Cy. Clk.

SIOUX CITY, IA.—The residents of Morning Side are trying to secure an extension of the works to that part of the city.

HUTCHINSON, MINN.—Bids are asked until June 5 for constructing works, including 14,316 ft. of 8 to 4-in. pipe, pump, water tower, etc. L. A. Ritter, Village Recdr.

KENYON, MINN.—The contract for constructing works has been awarded to Fairbanks, Morse & Co., St. Paul, at $4,500.

WINNEBAGO CITY, MINN.—The citizens have voted to issue $5,000 in bonds to complete the works.

LINCOLN, NEB.—The council has voted to construct five Cook wells at the South St. pumping station.

OSCEOLA, NEB.—The question of works has been postponed by the council.

UNIVERSITY PLACE, NEB.—The contract for works has been awarded to E. D. Rudiger, Nebraska City, at $13,795. The Fremont Foundry & Machine Co. bid $14,300 and Pomerene & Cooper, Lincoln, $13,613. Engr., A. A. Richardson, Lincoln.

WILBER, NEB.—An election will be held May 31 to vote on the question of works. Engr., A. A. Richardson, Lincoln.

CENTERVILLE, S. DAK.—The question of issuing $17,000 in bonds for works will soon be voted upon, according to reports.

WAKONDA, S. DAK.—It is stated that bonds will be issued for fire protection.

VALLEY CITY, N. DAK.—Bids are asked until May 22 for $10,000 of 6% water-works bonds. W. Crasswell, Cy. Audr.

HELENA, MONT.—Capt. Geo. S. Hoyt, U. S. A., will soon receive bids for works at Fort Harrison.

CLINTON, MO.—The Home Water-Works Co. has increased its capital stock from $28,000 to $100,000.

KIRKSVILLE, MO.—The contract for works has been awarded to the Consolidated Engineering Co., St. Louis, at $17,000, and sub-contracts have been awarded as follows: Two 80-HP. boilers installed, John O'Brien, Kirksville, $1,555; brick power house, C. C. Anderson, Kirksville, $1,025; pumps, Gardner Gov. Co., Quincy, $1,080; mains, National Tube Wks., $7,379.

RICHMOND, MO.—The citizens are reported as wanting works.

ST. LOUIS, MO.—Bids are asked by the board of public improvements until May 29 for engine pits and appurtenances at high-service station No. 3, the work including: 23,500 cu. yds. earth excavation, 17,800 cu. yds. earth embankment, 6,000 cu. yds. excavation in loose rock, 3,300 cu. yds. concrete, 6,210 cu. yds. stone masonry, 500 lin. ft. 60-in. iron pipe, 26,000 lbs. iron and steel, etc.; estimated cost, $130,000.

ST. LOUIS, MO.—The board of public improvements has authorized the purchase of $80,000 worth of pipe and has appropriated $155,000 for pipe-laying, including $130,000 for a main from the high-service engine house No. 3 to Brown Ave.

CALDWELL, TEX.—An injunction suit has been filed against the issue of the water-works bonds.

HEMPSTEAD, TEX.—It is stated that the construction of works to cost $9,000 is a certainty.

OAK CLIFF, TEX.—The city offers to furnish bonds for about one-half the cost of works and to take stock in works for same, if a company will put in a system. E. W. Foster, Mayor.

GRAND JUNCTION, COLO.—A petition has been presented asking for an election to vote on an issue of $50,000 in bonds for works. Works were built a few years ago by a private company, but the company's relations with the council are not reported as being very amicable.

LOUISVILLE, COLO.—An election was held May 8 to vote on an issue of $30,000 in bonds for works.

HOQUIAM, WASH.—Bids are asked for $24,000 of 6% 20-year water-works bonds. W. W. Lamb, Town Clk.

SIDNEY, WASH.—The contract for works has been awarded to T. A. Noble, Seattle.

SOUTH BEND, WASH.—The council has declared the contract with the water company null and void, the company not having completed the laying of pipes as was agreed.

GENESEE, IDAHO.—The committee has recommended works estimated to cost $13,500. A reservoir is included in the plans and an election will probably be held to vote on the question of construction.

COOKSHIRE, QUE.—E. S. Baker, Secy.-Treas., writes us that the contract for reservoir and laying water and sewer pipes from reservoir to the river has been awarded to Lieut.-Col. M. B. McAulay, Scotstown, at $7,500. Connecting the seven springs and the reservoir, one mile distant, will be done by day labor, as the bids were considered excessive; total cost, $17,000.

MONTREAL, QUE.—The contract for a Worthington pump, with turbines capable of developing 300 HP., has been awarded to John Macdougall, at $20,000.

BROCKVILLE, ONT.—The council has appropriated $30,000 for extending the works to the asylum. The city is to furnish the supply at 11½ cts. per 1,000 gallons and the government guarantees that a daily supply of at least 60,000 gallons will be used after two years.

IRRIGATION.

NIOBRARA, NEB.—Press reports state that the Niobrara Irrigation & Power Co. is planning to tap the Niobrara River about 300 miles west of the Missouri River and to construct a reservoir of about 40 sq. miles.

SANTA FE, N. MEX.—Surveys are being made for a storage reservoir for the Santa Fe Water Co. The dam will be 2,350 ft. long, 85 ft. high, 300 ft. wide at the bottom and 30 ft. wide at the top, according to reports, and it is estimated that the reservoir will be capable of irrigating 20,000 acres of land.

ELLENSBURG, WASH.—Bids are asked until June 5 for the sale of $200,000 of 6% bonds of the Middle Kittitas irrigation district. Jas. G. Boyle, Secy.

FILLMORE, UTAH.—The Pioneer Water Co. is reported as about to construct a reservoir to irrigate 5,000 acres.

TURLOCK, CAL.—Press reports state that the contract for the completion of the Turlock canal has been awarded to Doe, Hunt & Co., San Francisco, at $326,000. This, when completed, will bring the main canal four miles south of Turlock, making about 36 miles of main canal.

SEWERS.

LEWISTON, ME.—It is reported that important improvements to the system will be necessary within two years.

ROCKLAND, ME.—Bids are asked until May 19 for constructing 1,100 lin. ft. of 18 to 15-in. pipe sewers, and for furnishing sewer brick. F. M. Simmons, St. Comr.

LANCASTER, N. H.—It is reported that the committee will soon ask for bids for constructing sewers.

BOSTON, MASS.—The following bids were received for constructing a 36 × 30-in. brick sewer in Parker St.; National Construction Co., $11,679 (awarded contract); Dennis O'Connell, $11,739; A. A. Libby & Co., $11,906; Metropolitan Construction Co., $12,642; Fallon & Cronin, $13,487; H. P. Nawn, $15,143.

MALDEN, MASS.—The city has sold $100,000 of 4% sewer bonds to R. L. Day & Co., at a premium of $6,617.

MELROSE, MASS.—The town has voted to issue $100,000 of bonds for sewers.

WARE, MASS.—Plans have been prepared for a sewer estimated to cost $3,500.

WINCHESTER, MASS.—Bids are asked until May 25 for building about 6¾ miles of pipe sewers, as stated in our advertising columns. Ernest W. Bowditch, Co. Engr.

PROVIDENCE, R. I.—The council has voted to construct sewers in 13 streets.

NEW BRITAIN, CONN.—The commissioners are discussing the question of building sewers in the south western section of the city. Peter Long, Chn.

WATERBURY, CONN.—Bids are asked by the city engineer until May 30 for constructing a sewer in So. Leonard St.

BATAVIA, N. Y.—The board of health proposes to call a meeting to take action for improving the sewerage system.

BUFFALO, N. Y.—The lowest bids for constructing sewers in six streets were as follows: P. B. McNaughton, $8,300, $19,947, and $14,474; O. F. Dutro, $14,257; Buffalo Paving Co., $6,132 and $14,253.

PLATTSBURG, N. Y.—Geo. E. Waring, Jr., has been engaged to make a survey for a system of sewers for the Catholic Summer School. The grounds include 450 acres.

SARATOGA SPRINGS, N. Y.—Cramer & Eldridge are preparing plans for 200 ft. of pipe sewer in Nelson Ave.

ALTOONA, PA.—Ordinances have been passed by the council for constructing sewers in several streets.

APOLLO, PA.—It is proposed to construct a 24-in. sewer in Warren Ave. J. S. Whiteworth, Clk.

CHESTER, PA.—Bids are asked until May 21 for brick and pipe sewers. Jas. B. Campbell, Cy. Clk.

HARRISBURG, PA.—Bids are asked until May 21 for constructing 15 and 12-in. pipe sewers in two streets. A. U. Zarker, Comr.

ATLANTA, GA.—It is proposed to construct 24 to 10-in. pipe sewers in three streets, to cost $7,300, and a 99 to 60-in. brick sewer to cost $18,945. Park Woodward, Cy. Clk.

MERIDIAN, MISS.—The contract for constructing the sewer system has been awarded to Howard Neely, Chattanooga, Tenn., at $71,013. The bids were published in our issue of last week.

CLARKSVILLE, TENN.—Plans have been made for a sewer in Franklin St.

LEXINGTON, KY.—Plans and specifications have been prepared by Waring, Farquhar & Chapman for the proposed new sewers. P. P. O'Neill, Cy. Engr.

NEWPORT, KY.—Contracts have been awarded to Irwin & Co., at $31,000; Peter & Co., at $6,000; Wilson & Strack, $2,000; Jerry Hastings, $8,755; Ernert & Emory, $1,700; and it is expected that the construction will be commenced at once.

AKRON, O.—Bonds for $20,000 have been voted for a main sewer.

ASTABULA, O.—Plans have been prepared for a system, according to reports.

DAYTON, O.—Bids are asked until May 25 for constructing a storm water sewer in Webster St. C. A. Herbig, Cy. Comptroller.

CROWN POINT, IND.—The contract for constructing 83,930 ft. of pipe sewers has been awarded to the Garden City Paving & Post Co., Chicago, according to reports.

FRANKFORT, IND.—Bids are asked until June 1 for constructing a main sewer, as stated in our advertising columns. A. J. Hammond, Cy. Engr.

GRAND RAPIDS, MICH.—The board of public works proposes to construct a 48-in. main sewer, about four miles long and estimated to cost, including laterals, about $60,000, according to reports.

LANSING, MICH.—The mayor has recommended that the city engineer prepare plans for improving the system.

EAST ST. LOUIS, ILL.—The mayor has suggested that a main sewer be constructed to run north and south through the city.

PEORIA, ILL.—J. H. Harman, Cy. Engr., informs us that the lowest bid for constructing the Spring St. system was that of Robt. Clark, Peoria, at $30,187. The itemized bids will be published in a later issue.

ST. JOSEPH, MO.—The council is discussing an appropriation of $46,200 for sewers.

ST. LOUIS, MO.—Contracts have been awarded to the lowest bidders as follows: Skrainka Construction Co., $26,302; G. Eyerman, Jr., $1,655; R. Sheehan, $2,478; G. P. Prendergast, $27,384.

HELENA, MONT.—Plans for about two miles of sewers at Fort Harrison, have been approved and bids will soon be received by Capt. G. S. Hoyt, U. S. A., for the construction.

GODERICH, ONT.—It is reported that surveys are being made for a system of sewers.

STREETS.

BURLINGTON, VT.—The council has been authorized by the citizens to issue $20,000 of bonds each year for five years for improving the streets.

PAWTUCKET, R. I.—The council has passed an ordinance appropriating $15,000 for block paving and $13,552 for highway purposes.

DUNKIRK, N. Y.—Bids are asked until May 31 for 19,955 sq. yds. of paving, 10,232 lin. ft. of curbing, etc., as stated in our advertising columns. J. M. Hackett, Cy. Engr.

JERSEY CITY, N. J.—The city clerk has been directed to advertise for bids for repaving four streets with Belgian blocks.

ALLEGHENY, PA.—The contract for resurfacing the walks of the Allegheny city park with Seyssel rock asphalt has been awarded to the Wadsworth Stone & Paving Co., the Pittsburg agency of the New York Mastic Works. The board of public works has decided to advertise for bids for repaving 15 streets, estimated to cost $605,127. Robt. McAfee, Director.

ALTOONA, PA.—Bids are asked until May 26 for grading Eleventh Ave. M. V. Aruer, Chn. Com.

GREENSBURG, PA.—The citizens of Ludwick borough have voted to pave the main street with brick.

MAHANOY PLANE, PA.—Mark Bowman, Mahanoy City, has been directed to make a survey of the town for the purpose of paving the streets, according to reports.

MONONGAHELA, PA.—It is reported that R. T. Hallam & Sons, Washington, Pa., were the lowest bidders for paving to cost from $35,000 to $40,000.

NORRISTOWN, PA.—The council has granted a franchise to the Chestnut Hill Ry. Co. whereby the company is to pave 9,200 sq. yds. along the route of its road.

PHILADELPHIA, PA.—The council has passed ordinances for paving five streets with brick.

WILLIAMSPORT, PA.—Bids are asked until May 23 for repaving about 8,840 yds. with brick, as stated in our advertising columns. Wm. I. Driesbach, Cy. Clk.

BEDFORD CITY, VA.—The council is reported as about to take steps to pave several streets with brick, for which $20,000 was appropriated some time ago.

PORTSMOUTH, VA.—Bids are asked until May 25 for furnishing 83,000 paving brick, 1,380 lin. ft. curbing, etc. J. E. Orvins, Chn. Com.

MOUNDSVILLE, W. VA.—An election will be held soon to vote on issuing $20,000 in bonds for paving.

PARKERSBURG, W. VA.—Bids are asked until May 22 for paving several streets with brick, as stated in our advertising columns. W. H. Ogdin, Cy. Clk.

LOUISVILLE, KY.—Bids are asked by the board of public works until May 23 for paving 23 streets with brick, stone or blocks.

BELLAIRE, O.—The finance committee has recommended that bids be asked for paving Belmont St., and it is also proposed to pave five other streets.

CINCINNATI, O.—Bids are asked by the board of administration until May 24 for grading and paving two streets with brick.

PAINESVILLE, O.—The lowest bids for paving 14,000 sq. yds. with brick were as follows:

	Single course.	Double course.
Wm. Edwards	$15,581	
Wm. Barnett	16,796	
James Shelby	14,946	$17,922
John Hadley	18,308	
Maloney, Jamison & Maloney	18,160	
John Kelley	16,097	
Park Paving Co.	16,508	
McCloud & Girgie	15,387	
S. H. & C. R. McGood	14,735	19,800
Charles C. Roehl	14,866	24,997
M. J. Berry	14,490	18,289
McCracken & McDowell	14,554	19,936
Jacobs & Stewart	14,677	17,843
Wm. Baxter	16,504	
Herring & Straub	15,999	
John Lynch	18,570	
C. H. Burgess	16,306	
Davis & Archer	15,338	
Engineer's estimate	20,000	

SANDUSKY, O.—Bids are asked until May 31 for furnishing material and laying all sidewalks for the remainder of this year. A. W. Miller, Cy. Clk.

MOORHEAD, MINN.—Andrew Rinker, Minneapolis, has been engaged to prepare plans for paving Front St. with cedar blocks; estimated cost, $16,000.

ST. LOUIS, MO.—The lowest bids for improving Union boulevard were those of August and J. C. Herman, at $35,267.

HAMILTON, ONT.—The city engineer has been directed to prepare estimates for paving James and King streets with asphalt, with brick between the car tracks; esimated cost, $150,000.

ELECTRIC LIGHT AND POWER.

ELLSWORTH, ME.—A committee has been appointed to investigate the cost of a municipal electric light plant.

FAIR HAVEN, VT.—The village has contracted with the Carvers' Falls Power Co. for 100 incandescent lights and five arc lights at $1,700.

WEST RANDOLPH, VT.—J. A. Fowler is a member of a committee appointed to investigate the question of granting a franchise for an electric light plant to a local company.

HARTFORD, CONN.—The directors of the Hartford Electric Light Co. have voted to increase the capital stock from $250,000, to $350,000.

CHARLOTTE, N. Y.—A contract for 20 arc lights has been awarded to Michael Doyle, representing the Charlotte Light & Power Co., which has a capital of about $20,000 and proposes to extend its service to Summerville and Windsor Beach.

CUBA, N. Y.—A correspondent writes us that an election will be held May 18 to vote on the question of putting in an electric light plant at a cost of $8,000.

FREDONIA, N. Y.—The Fredonia Electric Light, Heat & Power Co., recently incorporated, will soon begin the construction of an incandescent light plant for this village.

SPRINGVILLE, N. Y.—The village has voted to issue $12,000 in bonds for an electric plant.

BLOOMFIELD, N. Y.—A local water, light and power company is being organized with a capital stock of $50,000.

ALLEGHENY, PA.—Bids are asked until May 22 for the erection of an addition to the electric light station, Arch., U. J. L. Peoples, Times Bldg.

WATERTOWN, PA.—It is reported that this place is considering putting in an electric light plant.

MILFORD CENTRE, O.—Bids are asked until May 26 for an electric light plant. J. G. Bennett, Village Clk.

CHESANING, MICH.—A plant is proposed. Address E. T. Long.

WHITE HALL, ILL.—The Greene County Electric Light Co. has been granted a franchise and awarded a contract for 30 arc lights of 1,200 c. p., at a cost of $1,200 a year.

DURAND, WIS.—An electric light franchise has been granted to Dr. F. J. Gobar.

MILWAUKEE, WIS.—Paul Muensberg, Chn. Com. noted last week, has proposed that the water power of the Milwaukee River might be utilized for generating electricity for the proposed municipal lighting plant.

RACINE, WIS.—The committee is reported as having decided to settle the electric light question by awarding contracts to two different companies, one company to light the north and west sides of the city, at $80 and $100 per light per year, and the other at the south side at $50 and $70 per light, the total cost per year being about $11,200.

HAWARDEN, IA.—Bids are asked until May 25 for putting in a 1,000-light incandescent municipal plant in accordance with plans prepared by W. H. Bryan, Consult. Engr., St. Louis, Mo. The city will pay cash for the plant.

BLOOMFIELD, NEB.—It is reported that Pierce, Wright & Co., the owners of the Bloomfield mill, are making arrangements to put in an electric light plant in this city providing the citizens will take 200 lights at $1 per month.

VICTORIA, TEX.—The council is considering a proposition for putting in an electric light plant in connection with the water-works.

OMAHA, NEB.—New bids will be asked for lighting the city. The bids recently received were published in our issue of March 1.

NEW COMPANIES.—Block Heat & Light Co., Camden, N. J.; $100,000; S. K. Robbins, Moorestown, N. J.——Wireless Armature Dynamo & Motor Co., Jersey City, N. J.; $100,000; Benj. Blum, Chas. S. Cowan, New York.——Crescent Electric Co., Chicago, Ill.; $10,000; W. H. Adams, Chas. Cohenour, Bernard Elshoff.——California Ground Electric Co., San Francisco, Cal.; $100,000; Frank Shay, G. W. Schell, N. M. Fay.

MISCELLANEOUS CONTRACTS AND SUPPLIES.

CITY HALL.—Worcester, Mass.—The city has been authorized to issue bonds for $300,000 for a city hall.

DRY DOCK.—San Francisco, Cal.—The California Dry Dock Co. is reported as about to replace the two old dry docks on Bryant St. with one large one.

DRAINAGE.—Ethel, Ont.—Bids are asked until May 21 for the construction of a drain estimated to cost $14,000. Engr., J. A. Bell, St. Thomas. Wm. Milne, Clk.

ENGINE HOUSES.—Springfield, Mass.—The mayor has signed the bill authorizing an issue of $29,000 in bonds for two new engine houses for the fire department.

CANAL.—Kearney, Neb.—Press reports state that the $60,000 of bonds voted at the last city election for the purpose of enlarging the Kearney Canal to 9,000 HP. have been signed by the mayor and city clerk and will be sent to Lincoln to be registered this week. Some preliminary work is now being done on the canal and as soon as the bonds are sold work will be pushed forward as rapidly as possible.

FORT.—Helena, Mont.—Bids are asked until June 11 for constructing on the site of Fort Harrison, near this city, three double sets officers' quarters, one guard house, one double barrack, one double set N. C. S. officers' quarters, one stable, one bakery, one storehouse, all of brick, and one scale house, frame building; also proposals for plumbing, steam heating and gas piping a portion of said buildings. The entire work will include sewers, water-works, etc. Capt. Geo. S. Hoyt, U. S. A.

HARBOR.—Aransas Pass, Tex.—A press report from San Antonio, Tex., states as follows: The contract between Manning & Cameron, of Pennsylvania, and the deep water committee for the improvement and securing of deep water at Aransas Pass, has just been signed. The contract calls for 20 ft. of water within six months. It will cost about $400,000 to build the jetties and the contractors are to receive for their work $600,000 worth of land lying in the neighborhood of the prospective new port. It is expected that the land will double in value when deep water is secured.

BIDS ASKED.

Paving, Cincinnati, O., until	May 18
Macadamizing, Pleasant Ridge, O., until	May 18
Sewer and sewer brick, Rockland, Me., until	May 19
Railway, 20 m., Texas Midland; Terrell, Tex.	May 19
Laying sewer pipe, Concord, N. H., until	May 21
Advertised in Engineering News, May 3.	
Paving, Middletown, N. Y., until	May 21
Advertised in Engineering News, May 10.	
Bridge, Renfrew, Ont., until	May 21
Stand-pipe and pipelaying, Rockport, Mass., until	May 21
Pipe and pipelaying, Bradford, Pa., until	May 21
Sewers, Chester, Pa., until	May 21
Sewers, Harrisburg, Pa., until	May 21
Water-works, Wapakonets, O., until	May 21
Drain, to cost $14,000; Ethel, Ont., until	May 21
Bridge, Calais, Ont., until	May 22
Advertised in Engineering News, May 3.	
Bridge, Brookline, Mass., until	May 22
Water-works, Quarryville, Pa., until	May 22
Advertised in Eng. News, May 10 and 17.	
Water tower, Peoria, Ill., until	May 22
Advertised in Engineering News, May 3.	
Water supply, San Francisco, Cal., until	May 22
Bridge, Providence, R. I., until	May 22
Electric light station ext'n, Allegheny, Pa., until	May 22
Stonework, 8 bridges; Mercer, Pa., until	May 22
Brick paving, Parkersburg, W. Va., until	May 22
Advertised in Engineering News, May 17.	
Water-works, Red Oak Junction, Ia., until	May 22
Water-works bonds, Valley City, N. Dak., until	May 22
Excav., etc., Gov't Bldg., Savannah, Ga., until	May 23
Advertised, Engineering News, May 3 and 10.	
Brick paving, Williamsport, Pa., until	May 23
Advertised in Engineering News, May 17.	
Paving, Louisville, Ky., until	May 23
Life-saving station, Charleston, S. C., until	May 24
Advertised in Eng. News, May 10 and 17.	
Bridge, Springfield, O., until	May 24
Advertised in Eng. News, May 10 and 17.	
Pump'g eng., pipe, etc., Springfield, O., until	May 24
Advertised in Eng. News, May 10 and 17.	
Water-works, Steubenville, O., until	May 24
Advertised in Eng. News, May 10 and 17.	
Brick paving, Cincinnati, O., until	May 24
Water-works, Dolgeville, N. Y., until	May 25
Advertised in Engineering News, May 10.	
Sewers, Elizabeth, N. J., until	May 25
Paving, Pekin, Ill., until	May 25
Advertised in Engineering News, May 10.	
Sewers, 6¾ miles; Winchester, Mass., until	May 25
Advertised in Engineering News, May 17.	
Paving brick, etc., Portsmouth, Va., until	May 25
Highway, Columbus, O., until	May 25
Sewer, Dayton, O., until	May 25
Electric light plant, Hawarden, Ia., until	May 25
Bridge, Cincinnati, O., until	May 26
Grading, Altoona, Pa., until	May 26
Railway, 6 miles; Petersburg, Va., until	May 26

Electric light plant, Milford Centre, O., until..May 26
Water-works, Milford Centre, O., until.....May 26
Street improvements, Avondale, O., until.....May 28
Paving, Dayton, O., until.....May 28
Water supply, Marine Hosp., N. Orleans, La...May 28
Advertised in Eng. News, May 10 and 17.
Bridge, Bryan, O., until.....May 28
Bridge, Brantford, Ont., until.....May 28
Water-works franchise, Alexandria, Ind., until.May 28
Advertised in Eng. News, May 17 and 24.
Pump'g engs. and stand-pipes, Youngstown, O.May 29
Advertised in Eng. News, May 17 and 24.
Excav., masonry, 60-in. pipe; St. Louis, Mo..May 29
Water-works, Danville, Ky., until.....May 30
Advertised, Engineering News, May 3 to 24.
Sewer, Waterbury, Conn., until.....May 30
Paving, Dunkirk, N. Y., until.....May 31
Advertised in Eng. News, May 17 and 24.
Sidewalks, Sandusky, O., until.....May 31
Highway bonds, Alpena, Mich., until.....May 31
Water-works, Tipton, Ind., until.....May 31
Advertised in Eng. News, May 17 and 24.
Electric lighting, Jackson, Tenn., until.....June 1
Sewers, Frankfort, Ind., until.....June 1
Advertised in Eng. News, May 17 and 24.
Elevator, Gov't Bldg., Galveston, Tex., until...June 1
Advertised in Eng. News, May 10 and 17.
Water-w'ks bonds, E. Cottage Grove, Ore., until June 1
Water-works, Farmington, Ill., until.....June 1
Advertised in Eng. News, May 17 and 24.
Electric plant, Newberry, Mich., until.....June 2
Bridge, Kansas City, Kan., until.....June 2
Water-works and pumps, Freehold, N. J., until June 2
Advertised in Eng. News, May 17 and 24.
Bridges, Fort Madison, Ia., until.....June 4
Government Bldg., Haverhill, Mass., until.....June 5
Advertised in Eng. News, May 10 and 17.
Iron work, etc., Univ. Bldg., Cincinnati, O.,until.June 5
Supplies, War Dept., Washington, D. C., until..June 5
Advertised in Engineering News, May 17.
Water-works, Hutchinson, Minn., until.....June 5
Irrigation bonds, Ellensburg, Wash., until.....June 5
Water-works, Penn Yan, N. Y., until.....June 6
Advertised in Engineering News, May 17.
Fort Harrison, U.S.A., Helena, Mont., until...June 11
Paving, Schenectady, N. Y., until.....June 12
Bridge, Hawkinsville, Ga., until.....June 13
Advertised in Eng. News, May 3 to June 7.
Water-works, Norfolk, Conn., until.....June 14
Advertised in Eng. News, May 17 and 24.
Highway, Little Rock, Ark., until.....June 18
Water-works bonds, Danville, Ky., until.....June 26
Water-works franchise, Florence, S. C.....No date.
Advertised in Eng. News, May 10 to 31.
Steam plant, San Angelo, Tex.....No date.
Advertised in Engineering News, May 10.
Water-works bonds, Hoquiam, Wash.....No date.

CONTRACT PRICES.

SEWERS.—Boston, Mass.—The metropolitan sewerage commissioners opened bids May 5 for the following work: Section 35, length 8,350 ft., av. cut to 10 ins. below invert 23.6 ft., maximum inside width 40 ins.; section 38, length 8,225 ft., av. cut to 10 ins. below invert 17.5 ft., maximum inside width 36 ins.; section 39, length 6,950 ft., av. cut to 10 ins. below invert 16.1 ft., maximum inside width 18 ins.; section 47, length 4,520 ft., av. cut to 10 ins. below invert 7.6 ft., maximum inside width 20 ins. The bids were as follows:

	Sec.38.	Sec.39.	Sec.47.
Jones & Meehan, Jamaica Plain.	$64,078	$59,849	$17,138
National Const'n Co., Boston...	47,812	36,865	11,999
Dennis O'Connell, Dorchester...	38,272	....	11,421
Chas. Lineham, Cambridgeport.	....	....	9,613
Genaro, Long & Little, Boston.	....	....	9,490
Ferguson Bros., South Boston..	....	....	9,356
L. A. Taylor, U.S.Hotel,Boston..	....	....	8,082
Lindsey & Cudmore, Somerville.	....	....	7,399
Edw. F. Brigham, W. Medford.	30,677	27,926	....
Met'p'n Const'n Co., Boston...	39,498	27,046	....
Jas. Heath & Son, Lynn.....	31,970	....	....

SEWERS.—South Milwaukee, Wis.—Bids were received May 8 for proposed sewers estimated to cost $18,170. Egg-shaped carbonized cement pipe will be used and the average cut will be 10½ ft. for 24 × 36-in. pipe, and 14½ ft. for the other. Engrs., Dousman & Sheldon, Milwaukee. We are informed that the contract will be awarded to the lowest bidder, and that the bids were as follows:

Bids Received for Constructing Sewers at South Milwaukee, Wis.

	24 × 36-in., 2,732 ft.	20 × 30-in., 2,738 ft.	12 × 18-in., 2,660 ft.	Manholes, 32.	Catch basins, 46.	C. b. connections, 46.	Discharge manhole, 1.	Concrete, extra.	Cement, ext'a, 400 lbs.	Lamp hole, extra.	Hemlock, extra.	Sewer brick, extra.	Totals.
John Crilley..	$2.94	$1.98	$1.42	$32.00	$32.00	....	$32.00	$2.50	$1.00	$2.00	$12.00	....	$20,762.72
Nic Forrestal.	2.45	2.00	1.30	30.00	30.00	$22.00	34.00	....	....	....	....	....	19,027.40
J. Kape & Son	2.80	2.00	1.39	40.00	30.00	13.80	50.00	7.00	.70	5.00	12.00	$10.00	19,986.00
McIntosh Bros	2.27	2.06	1.46	48.00	50.00	....	55.00	....	....	....	....	....	19,615.68
Jas. Markey..	2.43	2.07	1.49	35.00	25.00	10.00	50.00	5.00	2.00	10.00	10.00	10.00	19,099.18
Jacob Werner.	4.00	2.60	2.00	36.00	32.00	20.00	50.00	7.00	....	5.00	12.00	22.00	27,038.80
Wm. Forrestal	2.30	2.20	1.35	40.00	20.00	7.00	50.00	5.00	2.00	5.00	10.00	12.00	18,502.30
W. Gogtueck..	2.50	2.12	1.35	40.00	40.00	25.00	50.00	....	....	....	....	....	20,654.36
N. F. Reichert	3.00	2.00	1.00	40.00	25.00	7.00	50.00	9.00	2.00	2.75	16.00	9.00	19,178.00
M'Carty& Son	2.75	2.05	1.30	28.00	43.00	20.00	30.00	1.35	3.75	3.00	12.00	10.00	20,513.40

New Rochelle, N. Y.—J. K. Wilkes, Ch. Engr., informs us that the contracts for constructing sections 6 and 7 of the sewers, recently advertised, have been awarded to Wm. V. Molloy, at $35,218 and $32,331, respectively, the bids being as follows:

Section No. 6.	Freeman H. Merritt, White Plains.	Harry P. McFague, Mt. Vernon.	P. F. Brennan, New York.	Wm. V. Molloy, New Rochelle.
18-in. cast iron pipe sewer..	$3.03	$4.00	$4.00	$3.00
18-in. vitrified pipe sewer.....	1.38	1.70	3.00	2.00
10-in. " " "	2.48	1.25	1.50	1.05
8-in. " " "	2.03	1.15	1.40	.87½
6-in. " " "	1.56	.35	1.20	.75
5-in. " " "	.60	.25	.60	.65
5 × 18-in. Y's.....	3.06	1.70	3.90	2.25
5 × 10-in. "	1.18	.55	1.50	1.50
5 × 8-in "	.82	.40	1.00	.98
5 × 6-in. "	.54	.30	.70	.78
Manholes	55.00	50.00	50.00	60.00
Special manholes.....	100.00	130.00	60.00	100.00
Flush tanks.....	75.00	80.00	60.00	85.00
Rock excavation	3.25	2.40	3.50	3.50
Broken stone.....	1.75	1.50	2.50	1.25
Earth embankment	.80	.40	.60	1.00
Spruce piles.....	.75	.20	.55	.40
8 × 8-in. yellow pine.....	25.00	35.00	60.00	40.00

Section No. 7.				
18-in. vitrified pipe sewer.....	$3.43	....	....	$1.95
18-in. cast iron pipe sewer....	5.30	....	....	3.00
18-in. c. i., Ward flex. joint..	4.98	....	....	7.20
Manholes	55.00	....	....	60.00
Rock excavation.....	3.50	....	....	3.60
Broken stone	1.90	....	....	1.25
Spruce piles.....	.75	....	....	.40
8 × 8-in. yellow pine.....	25.00	....	....	40.00

PIPE.—Cincinnati, O.—The bids for cast iron pipe were as follows: Addyston Pipe & Steel Co., Cincinnati, $19.45 per ton for pipe and $45 for specials; Dennis Long & Co., Louisville, Ky., $22.97 and $60; Howard-Harrison Co., Bessemer, Ala., $20.75 and $40; Anniston Pipe Co., Anniston, Ala., $20.50 and $45; National Foundry & Pipe Wks., Stockdale, Pa., $21 and $45.

Metropolitan Sewerage System. Bids for Section 35, in Charlestown, Somerville and Medford.

Bidder.	Earth excav. and refill. 49 & 39 × 40 47-in., 3,360 lin. ft.	43-in., 35 × 690 lin. ft.	27-in., 22 × 4,300 lin. ft.	Brick mas'ry. American, 1,450 cu. yds.	Brick mas'ry. Portland, 520 cu. yds.	Conc'te mas'ry. American, 200 cu. yds.	Conc'te mas'ry. Portland, 70 cu. yds.	Spruce lumb. in place, 15 M. ft. B. M.	Rock excav., 1,300 cu. yds.	Totals.
National Construction Co., Boston.	$9.28	$7.22	$5.44	$15.00	$17.00	$6.00	$8.00	$40.00	$5.00	$99,004.60
Metropolitan Const'n Co., Boston..	9.35	6.03	5.50	13.75	15.50	5.50	7.00	40.00	6.50	97,864.20
Jones & Meehan, Jamaica Plain..	8.10	5.70	5.20	14.00	16.00	6.00	8.00	30.00	5.00	90,839.00
Lindsay & Cudmore, Somerville..	8.50	7.00	6.50	10.00	11.00	5.00	7.00	40.00	4.50	89,500.00
J. N. Drew & Co., Malden.....	8.85	6.70	4.80	12.00	13.60	5.50	6.90	35.00	5.00	88,079.00
Weaving, Booth & Co., Dorchester.	9.35	4.85	3.75	12.00	14.00	5.50	7.00	35.00	5.00	84,182.50
A. W. Bryne, West Medford.....	7.50	6.30	4.00	13.50	15.00	6.00	7.00	40.00	4.00	81,612.00
C. McBride, Brighton.....	7.50	7.50	4.00	13.00	16.00	5.00	6.00	35.00	5.00	83,190.00
Jas. Heath & Son, Lynn.....	6.30	5.55	2.75	14.00	15.00	6.00	7.00	35.00	4.65	73,182.50

SEWAGE DISPOSAL WORKS.—New Rochelle, N.Y.—J. K. Wilkes, Ch. Engr., informs us that the contract for the construction of the proposed sewage disposal works has been awarded to John New & Sons, at $13,572, the bids being as follows:

	John New & Son, New Rochelle.	F. H. Merritt, White Plains.	H. P. McFague, Mt. Vernon.	Cunneen & Smith, New Rochelle.	Peter Sweeney, Danbury, Conn.
18-in. c.i. pipe sewer, lin.ft.	$3.00	$2.75	$4.00	$4.50	$4.30
18-in. vit. pipe sew'r, lin.ft.	2.25	4.60	2.00	2.82	1.85
12-in. " " " " "	1.50	3.99	1.50	2.33	1.40
8-in. " " " " "	1.30	2.00	.60	1.85	1.10
Manholes, each	100.00	50.00	50.00	100.00	44.00
Brick masonry, per cu. yd.	11.90	13.00	10.00	14.60	12.60
Rubble stone masonry....	2.85	4.00	4.00	9.00	5.80
Concrete masonry, cu. yd.	9.50	7.00	5.50	14.00	7.80
Broken stone, per cu. yd..	2.75	1.90	1.50	3.00	1.50
Earth excav., " " " ..	.30	.98	.40	.60	.45
8-in. swinging effluent pipe	46.00	100	75.00	50.00	60.00
12-in. Ludlow sluice gate.	32.00	45.00	30.00	25.00	41.00
Blue stone plates, lin. ft.	.35	.50	1.00	.62	.50
Iron screen	12.00	20.00	25.00	10.00	6.00

It is stated that the contract for pipe last year was awarded to the Addyston Pipe & Steel Co., at $24.50 per ton.

Dansville, N. Y.—The contract for furnishing pipe for the water-works extension has been awarded to Jas. M. Edwards, Dansville, at $19.25 per ton.

Rutland, Vt.—E. V. Ross, Chn. Com., writes us that the contract for 5,000 ft. of 6-in. and 100 ft. of 8-in. water-pipe has been awarded to the Chattanooga Foundry & Pipe Wks., at $20 per net ton, f. o. b., Rutland.

CEDAR BLOCK PAVING.—Detroit, Mich.—Bids have been opened for paving five streets with cedar blocks on concrete, at a cost of over $90,000, the lowest being as follows: Talbot Paving Co., four streets, $1.58 to $1.78 per sq. yd.; Geo. E. Currie, one street, $1.72.

Crown Point, Ind.—Press reports state that a contract for 31,500 sq. yds. of cedar block paving has been awarded to the Garden City Paving & Post Co., Chicago, at $1.41 per sq. yd.

ASPHALT BLOCK PAVING.—Hudson, N. Y.—The contract for paving 10,000 sq. yds. in Warren St. with asphalt blocks has been awarded to the Hastings Pavement Co., 66 Broad St., New York, at $2.50 per sq. yd.

Poughkeepsie, N. Y.—A contract for paving 10,000 sq. yds. with asphalt blocks has been awarded to the Hastings Pavement Co., New York, at $2.50 per sq. yd.

STONE BLOCK PAVING.—Newburg, N. Y.—D. J. Coutant, Cy. Clk., writes us that the contract for 9,000 sq. yds. of block stone paving has been awarded to Wm. F. Hogan, 643 Tenth St., Brooklyn, at the following prices: Paving, $2.50 per sq. yd.; new bridge stone, 1,044 lin. ft., 75 cts. per sq. ft.; new curb stone, 20 × 4 ins. and 16 × 4 ins., 500 lin. ft., 60 cts. per lin. ft.; redressing old curb, 1,700 lin. ft., 27 cts. per lin. ft.

METAL MARKET PRICES.

LEAD.—New York: 3.37 to 3.4 cts. Chicago: 3.3 cts. St. Louis: 3.17 to 3.2 cts.

NAILS.—Pittsburg: $1 to $1.05 for wire, and 90 cts. for cut at mill.

FOUNDRY AND PIG IRON.—New York: $10.50 to $13.50. Pittsburg: $9.75 to $11.25. Chicago: $10 to $11.50.

TRACK MATERIAL.—New York: angle bars, 1.2 to 1.4 cts.; spikes, 1.5 to 1.7 cts.; track bolts, 2 to 2.1 cts. with square and 2.15 to 2.3 cts. with hexagon nuts. Chicago: angle bars, 1.25 to 1.4 cts.; spikes, 1.7 to 1.8 cts.; track bolts, 2.2 to 2.3 cts., with hexagon nuts.

RAILS.—New York: $24 to $25 at eastern mills and at tidewater; old rails, $11 for iron, and $9 for steel; light rails, $22 to $24; girder rails, $20.50 to $22. Pittsburg: $24 for standard sections. Chicago: $25 to $27; old rails, $10.50 for iron and $9.50 for steel.

STRUCTURAL MATERIAL.—New York: beams, 1.3 to 1.5 cts.; channels, 1.3 to 1.5 cts.; angles, 1.2 to 1.35 cts.; tees, 1.4 to 1.6 cts.; universal mill plates, 1.15 to 1.35 cts.; steel plates, 1.2 to 1.3 cts. for tank, 1.35 to 1.4 cts. for shell, 1.55 to 1.6 cts. for flange, 1.75 to 2 cts. for ordinary firebox, 2 to 2.25 cts. for locomotive firebox. Pittsburg: beams, 1.2 to 1.3 cts.; channels, 1.2 to 1.3 cts.; angles, 1.1 to 1.2 cts.; tees, 1.25 to 1.35 cts.; universal mill plates, 1.1 to 1.2 cts.; steel plates, 1.15 to 1.25 cts. for tank, 1.3 to 1.35 cts. for shell, 1.4 to 1.45 cts. for flange, 1.75 to 4 cts. for firebox. Chicago: beams, 1.35 to 1.4 cts.; channels, 1.35 to 1.4 cts.; angles, 1.3 to 1.4 cts.; tees, 1.5 to 1.6 cts.; universal plates, 1.3 to 1.35 cts.; steel plates, 1.35 to 1.4 cts. for tank, 1.5 to 1.6 cts. for shell, 1.6 to 2.1 cts. for flange, 2 to 5 cts. for firebox.

INDUSTRIAL NOTES.

THE HARVEY STREET CAR & REPAIR WORKS, Harvey, Ill., J. D. McIlwain, Genl. Supt., have recently been awarded a contract for repairing 400 cars for the Chicago Refrigerator car line.

THE OLD DOMINION CREOSOTING WORKS, Norfolk, Va., reports that the works have been rebuilt and improved since the fire of March 23, and they will now prepared to receive and fill orders.

THE WESTINGHOUSE ELECTRIC & MFG. CO., of Pittsburg, Pa., has a contract for 13 motors of 25 HP., one of 10 HP. and one of 5 HP. for the Ohio Steel Co., to operate the tables and other parts of the plant.

THE HASTINGS PAVEMENT CO., New York, N. Y., has contracts for 10,000 sq. yds. of asphalt block paving at Poughkeepsie, N. Y. It is also laying its pavement at Schenectady, N. Y., and 15,000 yds. are being put down on McCullough St., Baltimore, Md.

FRANK B. STONE, 21 Quincy St., Chicago, has furnished the Chicago Shipbuilding Co. with about 750,000 ft. of yellow pine for its new drydock at South Chicago. He makes a specialty of timber for railway and bridge uses, and has recently purchased 2,000,000 ft. of Oregon fir for stringers for the Chicago, Rock Island & Pacific Ry.

W. S. COON & SONS, of Toledo, O., have contracts for water-works at Somerset, Pa., and are completing the works at North Manchester, Ind. They also have contracts for the Ohio and Indiana oil pipe line and for street railways from Toledo to Perrysburg (six miles of double track) and Toledo to Maumee (4¾ miles of single track).

THE BUSHNELL MFG. CO., of Easton, Pa., manufacturing the Bushnell car seat, has established an agency in Chicago with the National Switch & Signal Co., 1236 Monadnock Block. It manufactures springs and car seats exclusively, and has been awarded contracts for furnishing the seats for 200 cars for the Metropolitan Elevated R. R., of Chicago, and also a contract by the Delaware, Lackawanna & Western R. R. Its goods are now in use on 24 roads.

NEW COMPANIES.—Illinois Dredging Co., Chicago, Ill.; $200,000; A. G. Jukes, I. G. Mosher and John T. Lillis.——Coffeyville Vitrified Brick Co., Coffeyville, Kan.; $20,000; W. H. Mahan, George Francis and C. T. Carpenter.——Rumson Improvement Co., Rumson, N. J.; $100,000; Edward Kemp, E. D. Adam and Cornelius Y. Bliss, of New York.——Keystone Gas & Fuel Co., Camden, N. J.; $125,000; F. S. Brown, W. R. Murphy, of Philadelphia, and H. F. Boyer, of Reading, Pa.——Pecos Valley Scouring Mill & Water Power Co., Roswell, N. M.; $50,000; A. M. Robertson, B. F. Daniels and J. B. Trotter.——Columbia Brick Co., Columbia, Pa.; $20,000; Treas., J. L. Purple, Columbia, Pa.——McLaughlin Automatic Safety Switch Co., Chicago, Ill.; $200,000; J. C. McLaughlin, G. N. Griffin and W. R. Mason.